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SCIENCE & TECHNOLOGY

EUROPE & LATIN AMERICA

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VOLKSWAGEN SUBSIDIZES RESEARCH ON TITANIUM COATINGS

Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 459-460, 20 Jul 87 pp 8-9

[Text] Titanium is increasingly being used in aeronautics, turbine construction and in the chemical industry, because of its favorable combination of qualities such as high melting point, extreme hardness and low weight. However, because it oxidizes at high temperatures, the metal causes some problems--this is one of the reasons for metallophysical [metallphysikalisch] changes to further improve its coating qualities. Extremely thin layers of copper or nickel, for example, are placed on titanium surfaces (ion plating), or ions are injected into the surface (ion implantation) in order to improve adhesion, wear resistance, and corrosion resistance. The Volkswagen foundation and the German research community have granted subsidies to the work group for "experimental physics III" in the physics faculty of the General Technical University in Kassel (GhK) led by Professor Dr Helmun Gartner to conduct research in this field.

The Volkswagen Foundation has provided a total of DM604,000 for a joint project between the Institute for High Frequency Technology (under Professor Hartnagel) and the Institute for Applied Physics (under Professor Pagnia) of Technical University, as well as the Kassel research group within the framework of the research priority "Microcharacterization" of materials and components. The project deals with the development and application of the scanning tunnel microscope to examine the surface of the metal.

The DFG [German Research Association] granted Professor Gartner approximately DM187,000 for a computer controlled Guinier diffractometer. The influence of ion plated layers and surface implanted ions on the corrosion and oxidation reaction, as well as on the wear and [the endurance limit] of titanium can be examined with this instrument.

According to Prof Gartner, not only is the intensive cooperation in this project with colleagues at the Darmstadt Technical University and the Association for Heavy Ion Research (GSI) noteworthy, but also the cooperation within the Kassel Technical University with the Institute for Materials Technology (under Professor Wagener), as well as the previous achievements of his colleagues Dr Klaus Thoma and Dr Thomas Wieder. Even more satisfying is the fact that the preliminary work for the currently subsidized project was carried out exclusively in the context of undergraduate work in the integrated

machine construction curriculum at the Kassel Technical University (by Hucke, Exner, Riebeling, Farber and others). The Kassel program of offering physics as a 3-hour compulsory lecture within the primary machine construction curriculum, which is unique in the FRG, has also proven fruitful with regard to research--besides the fact that participating students can easily find good positions in industry at the end of their studies at Kassel Technical University.

8701
CSO: 3698/M401

FRG APPROVES PARTICIPATION IN HERMES, ARIANE; PONDERS FUNDING

Riesenhuber Approves Funds

Frankfurt/Main FRANKFURTER ALLGEMEINE ZEITUNG in German 29 Jul 87 p 11

[Article: "The Cost of European Space Travel Rises Steadily--Germans Fund Three Big Projects With DM 15 Billion/Riesenhuber Recommends Participation"]

[Text] K.B. Bonn, 28 July. Heinz Riesenhuber, FRG minister of research, wants to recommend to the cabinet FRG participation in the planned European astronautics program. Riesenhuber gives a figure of DM 65 billion for the total cost. The German contribution would amount to DM 15 billion, calculated in terms of 1986 prices. While Riesenhuber clearly states that study of the project on the basis of a long-term program of the European space organization (ESA) is still in an interim-balance stage nevertheless he recommends three planned projects: the higher-thrust transport rocket Ariane, the Hermes space transporter, and participation in the American space station (Columbus).

Riesenhuber is convinced that the program is technically and financially feasible. He considers that what is involved is a well-thought-out design for projects which fit well together. He asserts that for economic reasons, reasons of research policy, foreign policy, and security policy the program is necessary for Europe. Riesenhuber wants to use the limited time available before the ministerial council meeting of the ESA in the beginning of November to work jointly with other governments to somewhat reduce the total costs. But he considers that if the program is to retain its logic it will be necessary to set limits to such cost reduction.

The research minister considers it to be imperative that the FRG shall with France take over a leading role in European astronautics. He feels that not to start the program would involve the greater risk. To delay climbing aboard would not only be more expensive it would also render it more difficult to establish American and Russian connections. And he observes that also the Japanese, who are currently talking about a $100-million program, must also be taken into consideration in the domain of astronautics.

Riesenhuber also expects joint European and transatlantic projects in astronautics to be an integrating force. The research minister makes no secret of his fears that Europe and the United States may develop along diverging paths in research and science. Closer European-American cooperation in astronautics would counterpoise any development tending to impede the exchange of technology and scientific knowledge in the West.

Riesenhuber sees the greatest difficulties for all partner countries in the problem of financing the projects. The German government is not alone in facing difficult decisions. These decisions are particularly difficult since in addition to the German contribution to the joint projects it will be necessary to sustain a national astronautics program having an order of magnitude of DM 10 billion. Just the annual FRG contribution to the three big projects will come to DM 3.5 billion in the year 2000 if one takes into account annual price increases of 2.5 percent.

Finance Minister Gerhard Stoltenberg, who moreover is worried about unanticipated financial risks of space travel, has thus far maintained that he would not additionally finance price increases. Up to now the German federal government has only reached preliminary decisions. Still in the future is not only evaluation of financial questions but also the cabinet has yet to agree on the overall basic resolutions. Presumably this will take place in October. In setting up a framework for Ariane and Hermes by the cabinet fundamental agreement has been reached to the effect that Riesenhuber shall pay 50 percent out of his budget and that the other half shall be provided out of the federal budget. Riesenhuber believes that such a sharing will be necessary if fundamental research and environmental research are not to be damaged by astronautics.

That the ESA council of ministers will make final decisions as early as November is open to question. Most of the governments including the German delegation have in the last council session at the end of June raised serious questions with regard to the proposals. The criticism has been raised by many countries that certain technological questions still remain open. Besides, there is doubt whether enough qualified personnel are available in Europe to handle all three projects. And Riesenhuber himself does not accept the proposals in all respects. He concedes that there are still questions awaiting clarification. Nevertheless, he considers the overall concept to be "fairly mature."

Editorial Questions Policy

Frankfurt/Main FRANKFURTER ALLGEMEINE ZEITUNG in German 29 Jul 87 p 11

[Article: "Risky High Flying"]

[Text] K.B. Heaven-storming enthusiasts everywhere in Europe want to emulate the Americans and Russians in joint astronautics. If an industrial nation wants to retain its prestige it must also reach for

the stars. This is the opinion now of Research Minister Riesenhuber in an enthusiasm which he shares with Foreign Minister Genscher. There is no question but that many reasons may be adduced to justify cooperation of Europeans with the United States in space exploration. But such high flying can be risky. Thus far it has not been possible to accurately estimate the financial risks. Whether three European big projects can be simultaneously paid for and staffed with personnel is a question which still requires deeper study. For this reason the negotiations over the future program of the European space organization ESA should be freed from time pressure. It is not possible to make instant decisions regarding serious budget burdens extending into the next century. This would not be possible in an individual country and certainly not in a combination of countries. In Bonn the financing question has hitherto been dealt with only in narrow terms relating to the question of just how much the research minister could set aside for astronautics from his budget. On the other hand the decisive issue is the need to determine politically just what other financial obligations should be given priority ahead of the billions for space travel.

Long-Term Costs Estimated

Duesseldorf VDI NACHRICHTEN in German 3 Jul 87 p 1

[Article by Wolfgang Mock: "Space Research in the FRG: The Problems Are Not Only Problems of Money--Funding Grab or Innovative Hope of the Future?--European Cooperation Is Still Far From Making All Participant Partners Equal"; first paragraph is VDI NACHRICHTEN introduction]

[Text] VDI-N, Duesseldorf, 3 Jul--For the first time research and development expenditures of the FRG for astronautics in 1986/87 soared above the DM 1-billion level. Almost half of this went to the European space authority ESA. Now with the announcement of our own national space agency and of the long-term formulation of a national space policy it has become evident that these costs will rise further. Therefore critics are now warning against decisions extending too far into the future and plead for a flexible policy.

Just 2 weeks ago the FRG decided to approve an extension of the preliminary programs for the three big European space projects: for a European research platform as a contribution to the manned American space station, for Ariane V, the advanced version of the European transport rocket, and for Hermes, a European shuttle carrying a three-man crew. The costs for the extension phase alone amount to DM 255 million and when the complete preparatory phase for all three projects has terminated by the end of this year it will have made the German taxpayer poorer by more than DM 500 million.

Thus the preliminary outlays are substantial. That the normative effect of actual facts, namely the size of these preliminary expenditures, may lead to ever newer and ever more expensive investments is not only a fear preoccupying critics of FRG astronautics but in itself appears to

be not quite unfounded. While in the FRG Ariane, Hermes, and Columbus are looked upon as long-term designs, the French are already pushing the idea that a logical sequel to Ariane and Hermes would be a European manned space station.

Altogether, according to careful estimates, in the next 10 years just the three big European projects alone will impose obligations of DM 7.5 billion upon the FRG. In the FRG the case of the fast breeder in Kalkar has shown what clay feet can underlie the cost estimates of large-scale research projects. And this is not the only such case. In 1984 NASA calculated the cost of a manned space station to be $8 billion. In consequence of the Challenger accident these calculations doubled and further cost explosions are predictable.

A shorter-term alternative which might therefore be desirable would be to adopt a policy of heavier concentration upon transport systems, through which at least over the short term a greater commercialization of space research would be possible. That alternative has been recommended, during conversation, by the SPD deputy and chairman of the German Federal Committee for Research and Technology Wolf-Michael Catenhusen. According to Catenhusen to design Ariane V just as a transport rocket for Hermes would make the Ariane V steadily diminish in suitability for such cargo flights.

Certainly, warned ESA chief Reimar Luest in a hearing before the German Federal Committee for Research and Technology, spaceflight is still far away from commercial usefulness.

Thus it is more important first of all to develop new technologies at the European level. And yet, nevertheless, according to Erich Riedl, coordinator of German aeronautics and astronautics in the Ministry of Economics, cooperation in the ESA is in no sense a guarantee of technological transfer between the individual ESA partners. For at that same hearing he asserted: "It has turned out on the whole to be disadvantageous that in the Ariane V and Hermes programs the ESA exercises only slight influence on program control. Planning and decisions in configuring the systems has been assigned to CNES, the French national space agency." In this sense the FRG, which participates in Hermes financially to the extent of 30 percent and in Ariane with 22 percent, must stand on the outside looking in.

Industry Supports Participation

Duesseldorf HANDELSBLATT in German 24-25 Jul 87 p 1

[Article: "Space Travel/Attitude of German Industry--At DM 2 Billion Annually an 'Entry Ticket' Gets More Expensive"]

[Text] HANDELSBLATT, Thursday, 23 Jul, hjs Bonn. German industry favors intensified involvement of the FRG in astronautic policy and is also prepared to apply its own resources to the extent that there are prospects of future utility.

This has been the message of a position announcement released by the Federal Union of German Industry (BDI) with regard to space policy. It is the view of the BDI that a strengthening of involvement would, however, be acceptable in the context of industry generally only if such involvement were embedded within a balanced and adequately subsidized overall concept for research and technology policy.

This announced position of the BDI has taken place in the foreground of decisions by the German federal government with regard to Bonn's future space policy. The federal research minister Heinz Riesenhuber is at the present time working out a new plan which he hopes will fit the limited financial capabilities of the FRG. It is expected that after the summer break this plan will be endorsed by the cabinet.

The BDI considers that independent competence on the part of the FRG in the area of astronautics is desirable in the interest of maintaining an international competitive position. To the BDI it is clear that the "admission ticket into the new dimension of German and European space travel will not be cheap." The BDI estimates that the German expenditures for astronautics in the coming years will be at least DM 2 billion annually. That is twice previous estimates.

Since further engagement of industry could be expected to take place only upon the foundation of a broadly and securely based research and technology there now arises once more, in the view of the BDI, a question as to the future character and scope of that indirect research support which is so "totally indispensable" for small business enterprises.

The BDI emphasizes that on the basis of Germany's capabilities the FRG should participate in Europe's joint astronautic tasks and should exercise a formative influence upon their programs.

The point is that while long-term "vital markets" arise out of the industrial application of scientific discoveries, it is nevertheless also true, says the BDI, that besides scientific and industrial competence there is also a need for "political courage, decisiveness, and the ability to follow through."

8008
CSO: 3698/600

ITALIAN NATIONAL BIOTECHNOLOGY PROGRAM DEVELOPED

Rome GAZZETTA UFFICIALE DELLA REPUBBLICA ITALIANA in Italian No 169, 22 Jul 87 pp 23-25

[Decree of the Italian Minister for the Coordination of Scientific and Technological Research concerning the National Program for Biotechnological Research; issued 10 July 1987 in Rome]

[Excerpts] Specific research objectives of the national research program in the area of advanced biotechnologies aimed at the development of highly innovative and strategic technologies for industrial applications in the medium term.

The Minister for the Coordination of Scientific and Technological Research

Article 1

The national research program in the area of advanced biotechnologies aimed at developing highly innovative and strategic technologies for industrial applications in the medium term--defined by the Minister for the Coordination of Scientific and Technological Research and approved by a CIPI [Interministerial Committee for the Coordination of Industrial Policy] resolution of 28 May 1987--for research activities totaling 209 billion lire, is divided into the following specific themes:

Medicine and Veterinary Medicine Area

Theme 1--Monoclonal antibodies for diagnostic use

Scope of research

Development of new technologies for production and characterization of innovative nonoclonal antibodies to be used in both in vivo and in vitro diagnostics.

Development of procedures designed for the use of monoclonal antibodies in rapid and sensitive detection systems. Development of technology

of large-scale cultures for producing hybridomes and for purification processes at an industrial level.

Analysis and evaluation of the spin-offs from the results.

Research is divided into four sub-themes:

1) Preparation of hybridomes capable of producing monoclonal antibodies to be used as reagents in the preparation of at least six diagnostic kits, two of which are designed for the area of infectious diseases, another two for the area of tumor markers, and the remaining two for the area of autoimmune diseases. Development of kit production technologies for all components included. Production of standard series for each kit, which are sufficient to carry out a statistically significant study on clinical and analytical tests in compliance with the protocols established by international standards.

2) Development of bi-functional monoclonal antibodies obtained through the fusion of two hybridomes to be used as reagents in immunocytechemistry. Development of at least two standard analytical systems; control of their performance and clinical significance according to international protocols.

3) Definition of procedures designed for hybridome culture and scale production of monoclonal antibodies by means of fermentors, flat membrane or hollow fiber reactors, immobilization matrices. Development of at least one device for scale production and testing of its operation through the production of one monoclonal antibody in at least three lots; each lot must have a minimum protein content of 100g.

4) Production of antibodies in which a part of the coding gene is linked to the gene of an enzyme or of another molecule used as a marker. Expression in a suitable host for directly producing monoclonal antibodies which are marked by biosynthesis.

Duration:

Research must not exceed 48 months.

Cost:

Maximum cost inclusive of VAT must not exceed 7 billion lire.

Theme 2--Nucleic acid probes.

Scope of research

Definition of technologies designed for the use of DNA or RNA probes and definition of the relevant marking techniques with isotopes, enzymes, fluofors [fluofori], etc., to identify hybridization reactions in order to produce industrial reagents (kits). Development of production and purification procedures of the probes through chemical synthesis or by biological methods. Definition of probe marking methods and of industrial production procedures concerning all the components making up the resulting diagnostic kit. Development of analysis methods designed so as to enable their widespread use in diagnostic practice with particular respect to simplifying sample treatment procedures, testing conditions of hybridization reaction, sensitivity/accuracy characteristics of the assay. The resulting diagnostics kits are to be produced in sufficient quantity to enable their characterization through evaluation stages based on protocols as established by international standards.

Analysis and evaluation of the areas interested by the incidental impact of the results.

Research is divided into three sub-themes:

1) Development of at least five different industrial kits designed for the identificiation of five infective agents (viruses and baceria), including mutants resistant to antibiotics and chemotherapeutic drugs.

2) Development of at least two enzyme kits for defining genetic defects in prenatal diagnostics by means of direct hybridization of the defective gene or through the RFLP (Restriction Fragment Length Polymorphism) approach.

3) Development of at least one enzyme kit to determine the antigens of histocompatibility between individuals and of genetic susceptibility to developing autoimmune diseases.

Duration:

Research must not exceed 60 months.

Cost:

Total cost inclusive of VAT must not exceed 8 billion lire.

Theme 3--Technologies of plasmatic protein characterization and separation.

Scope of research

Development of advanced technologies designed for the characterization of unidentified plasmatic proteins and of other plasma factors for potential therapeutic use. Development of selective separation technologies of plasmatic components by preparatory affinity chromatography with cloned or synthetic antigens and with immobilized antibodies. Such technologies are designed also for use in therapeutic plasmapheresis both through line insertion of separation media and through preparation of treated plasma. Development of high-sensitivity techniques for identification of antigens and of genetic material of infective and/or pathological origin in donors' blood samples.

Analysis and evaluation of the spin-offs from the results.

Research is divided into three sub-themes:

1) Fractionation of normal and pathological plasma by means of suitable technology; for example, bi-dimensional electrophoresis with computerized detection. Identification of significant components and determination of the partial amino acid sequence detected on electroeluted material. Production of antipeptide antibodies and component separation by immunoaffinity: biopharmacological and biochemical characterization of this component.

2) Preparation attained through rDNA or synthesis separation of antigens connected to pathogenic antibodies: immobilization of the antigens thus obtained on chromatographic supports and antigen use to separate antibodies of specific therapeutic interest or to remove pathogenic antibodies from the plasma.

3) Use of antipeptide antibodies to fight invariant areas of viral antigens in order to define immunoassays for plasma control of donors.

Duration:

Research must not exceed 60 months.

Cost:

Total cost inclusive of VAT must not exceed 20 billion lire.

Theme 4--Fibrinolytic enzymes modified through rDNA technologies.

Scope of research.

Isolation and production of thrombolytic enzymes for therapeutic purposes; these enzymes have been modified through rDNA technologies in order to display the following characteristics: greater specificity,

fewer side effects, and longer permanence in the bloodstream as compared with "natural" products.

Critical evaluation, which if necessary, can also be supported by the development of suitable procedures, of the risks associated with the research and with the use of the results obtained.

Research is divided into four sub-themes:

1) Genetic recombination of the domains of fibrinolytic enzymes and of other plasmatic proteins of potential interest; for example, affinity with fibrin, collagen, and lipids.

2) Expression of recombined genes and of genes that have undergone the process of mutagenesis in suitable micro-organisms and/or eukaryote cells.

3) Definition of preparation and purification procedures of selected proteins.

4) Development of the production process and implementation of the latter on a pilot scale; biological, biochemical, and clinical evaluation of the substances obtained.

Duration:

Research must not exceed 60 months.

Cost:

Total cost inclusive of VAT must not exceed 12 billion lire.

Theme 5--Technologies developed for the synthesis and post-translated modifications of polypeptides of pharmaceutical interest.

Scope of research.

Development of technologies for the production of substantial and cost-effective quantities of polypeptides through the culturing of micro-organisms or engineered cells containing the suitable genetic system.

Definition of technologies designed for carrying out post-translational modifications necessary for making polypetides and proteins more active or less degradable, particularly as regards the ones obtained through rDNA.

Research is divided into four sub-themes:

1) Mass-cloning of more than one gene copy including those obtained by use of chemical synthesis, with respect to the polypeptide in question. Definition of the best conditions for polypeptide expression, isolation, purification and production.

2) Purification and characterization of an amidase enzyme to be derived from a suitable natural source. Isolation and cloning of the gene in a micro-organism suitable for enzyme production on an industrial scale. Development of enzymatic amidation technology by preparation of a bioreactor for the amidation of polypeptides through enzyme immobilization. Evaluation of the prospects offered by the possibility of gathering into one single cell, through rDNA techniques, the production of the protein and that of the amidase enzyme.

3) Development of sitospecific mutations of both the amidase enzyme, to vary its substrate affinity, as well as of biosynthtetic peptides, in order to obtain greater biological activity and better resistance to chemical agents and enzymes.

4) rDNA technologies of mammal cells, development of carriers for cloning, secretion, and post-translational modification of polypeptides.

Duration:

Research must not exceed 60 months.

Cost:

Total cost inclusive of VAT must not exceed 18 billion lre.

Theme 6--Monoclonal antibodies for immunotherapy.

Scope of research.

Development and clinical demonstration of technologies aimed at large-scale production of human, chimeric, bifunctional and anti-idiotypic monoclonal antibodies. Definition of procedures connected with their use in clinical applications in pathologic sectors associated with infectious diseases and in immunotherapy. Definition of technologies, on a large-scale, of hybridome producing culture and of purification processes at an industrial level.

Analysis and evaluation of the spin-offs from the results.

Critical evaluation, which, if necessary, can even be supported by the

development of suitable procedures, of the risks involved by research and by the use of the results obtained.

Research is divided into five sub-themes:

1) Preparation of chimeric or human monoclonal antibodies for in vitro immunization of human lymphocites and for fusion with myeloma cells of mice, rats, or human beings.

2) Definition of rDNA techniques in which the coding genes of the variable parts of a monoclonal antibody are inserted in plasmids containing the constant parts of human immunoglobulins and are transplanted in a suitable expression host.

3) Production of anti-idiotypic antibodies of normal and pathologic receptors and/or of their effectors.

4) Identification and selection of antibody fragments capable of reaching a suitable concentration in target points.

5) Development of production technologies and of a pilot plant designed for semi-industrial production of monoclonal antibodies for therapeutic purposes.

Duration:

Research must not exceed 60 months.

Cost:

Total cost inclusive of VAT must not exceed 13 billion lire.

Theme 7--Immunotoxins and other related products.

Scope of research.

Identification of complex substances, which are made up by the union of two substances, one of which is a toxin or a protein modified if necessary and which acts as an inhibitor of cell growth, while the other is an effector, such as an antibody or another substance, featuring positive tropism towards target cells. Definition of the relevant production processes and clinical experimentation of the active substances produced.

Critical evaluation, which, if necessary, can even be supported by the development of suitable technologies, of the risks associated with the research and with the use of the results obtained.

Research is divided into four sub-themes:

1) Identification of proteins capable of inhibiting the growth of human cells.

2) Identification of molecules which prove affinitive in their membrane cellular components; for example, monoclonal antibodies, cellular growth factors, and chemical fusion of such molecules with inhibiting proteins.

3) Cloning, expression, and definition of a production process for inhibiting proteins and for active substances (development of the relevant hybridome in the case of growth factors of a proteic nature, human cell culture in other cases). Fusion of the two genes which determine the code of the two types of substances, cloning and expression of the resulting gene in one single organism.

4) Production to be carried out by way of the above mentioned process of at least one active substance on a semi-industrial scale; experimentation, and clinical evaluation of the product.

Duration:

Research must not exceed 60 months.

Cost:

Total cost inclusive of VAT must not exceed 10 billion lire.

Theme 8--Biologically active microbial metabolites.

Scope of research.

Identification and development of drugs produced by micro-organisms or by new molecules which are the founders of drug families of interesting use in veterinary or human medicine.

Critical evaluation, which if necessary, can even be supported by suitable procedures, of the risks associated with the research and with the use of the results obtained, with particular regard to the level of ecological impact.

Research is divided into four sub-themes:

1) Generation of producing micro-organisms by means of innovative techniques and application of suitable procedures for genetic

modification (mutation, recombination, transformation, and cloning of specific genes).

2) Micro-organism classification through biochemical and morphological analyses and setting-up of a bank of antinomyce and fungi breed.

3) Definition of new in vitro assays, designed to point out substances produced by micro-organisms by using genetic and biochemical procedures, which form the basis of pathological phenomena. Evaluation of prospective therapeutic activity of the substances produced on human beings (antimycotic, antibacterial, antiviral, antitumor, and also including activity on the cardiovascular and central nervous system), and on animals (activity of antimicoplasmic, antielminthic, anticoccidiotic, and antimycotic type).

4) Development and application of new fermentation and production technologies of active substances on semi-industrial scale and clinical experimentation of the active substances produced.

Duration:

Research must not exceed 60 months.

Cost:

Total cost inclusive of VAT must not exceed 11 billion lire.

8606
CSO: 3698/M413

DUTCH FIRM REQUESTS FIELD TESTS OF GENETICALLY ALTERED POTATOES

Rotterdam NRC HANDELSBLAD in Dutch 18 Sept 87 p 13

[Text] The biotechnological firm of Mogen in Leiden has requested that the Ministry of Housing, Planning & Environmental Protection grant it permission to carry out field tests of genetically altered potatoes.

The tests are intended to find out whether the potato plants will retain their familiar properties if genetically altered. The gene that is inserted into the potato species (among others, Bintje) in the laboratory tests contains hereditary properties which can protect the plant from a disease to which the plant is at present nonresistant.

Mogen declines to give the name of the disease. According to Dr. P. van den Elzen, scientific director, that is of no significance right now. The tests are intended for the sole purpose of finding out whether the applied technique will also give good results when the plants are cultivated under other conditions than those of the laboratory. If this appears to be the case, various forms of resistance may be incorporated in the plants.

Van den Elzen expects a decision in the near future from the Ad Hoc Committee on Recombinant DNA Activities of the Environmental Conservation Board, which is considering the request. Prof. Dr. P.G. de Haan, chairman of the said committee, says that he does not expect any 'real difficulties' in conjunction with this request. "It would be different if it were a question of tests involving plants which are resistant to weed killers, in which case one runs the risk that weeds in the countryside become resistant."

The committee has laid down guidelines for experiments with genetically altered growths in the environment. So far such tests still belong under the Private and Public Nuisance Act, but van den Elzen expects the regulation to become incorporated under the Act Against Substances Dangerous to the Environment next year. That act applies to the entire country, which makes it easier to undertake tests in various regions. Different regulations apply to specific regions under the Public and Private Nuisance Act.

An improved variety of Bintje may be of great commercial value. That potato is extremely popular, and cultivators have not yet been able to improve it. By the end of next year, with the help of field tests, Mogen hopes to demonstrate that a new 'geno-type' of Bintje may be produced.

Mogen in Leiden was set up in 1985 by the American Molecular Genetics. The enterprise has in the meantime become independent. Eleven percent of the stock is still in the hands of the Americans, 15 percent belongs to the Industrial Projects Company, while the remainder belongs to institutional investors.

7262
CSO: 36980018

BMFT OFFICIAL REPORTS LATEST BIOTECHNOLOGY ACHIEVEMENTS

Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 459-460, 20 Jul 87 pp 4-5

[Text] Following up on a request from Bundestag member Heinz Seesing, the parliamentary secretary of state at the BMFT [Federal Ministry for Research and Technology], Dr Albert Probst, has reported on research results in the area of genetic engineering, especially in application-oriented research:

The genetic center in Cologne has made advances in the research of Alzheimer's disease. A group of scientists succeeded in identifying and cloning certain genes which characterize a protein closely connected with Alzheimer's disease. This supports an earlier hypothesis that this disease has mainly genetic causes. genetic causes.

At the genetic center in Munich, genes of membrane-proteins of a highly pathogenic bacteria (Pseudonomas) have been isolated and identified. This bacteria has long been considered a "problem germ" because successful therapy with conventioal antibiotic is not possible. The Munich scientists succeeded in identifying these genes in a nonpathogenic organism. The genetic products (proteins) can be used in the production of a vaccine for antibiotic-resistant pathogenic agents.

At a research center in Heidelberg it has been possible to make considerable progress in the area of tumor diagnostics by using molecular biological methods. The objective is the development of a sensitive indicator of keratin in tumor cells.

A group of scientists in Munich demonstrated at the beginning of the year that interferon produced with genetic engineering methods represents an [effective] therapy for polyarthritis in 50 percent of all cases. The experimental results are yet to be confirmed by large-scale clinical studies.

A group of scientists in Heidelberg succeeded in isolating and characterizing gylcene and gaba receptors [Glycin-und Gabarezeptoren]. This was also an important scientific advance on an international scale in that important basic neurobiological phenomena can be brought nearer to clarification. In the future, these phenomena will enable interesting applied research work in neurobiology.

A complete survey of advances in genetic engineering for 1987 can probably only be presented at the end of the year.

8617
CSO: 3698/M398

FRENCH MAIA EXPERT SYSTEM DISCUSSED

Paris ZERO UN INFORMATIQUE in French 11 May 87 p 9

[Article by Pierre Lombard: "AMAIA Product Announcements: French-Style Artificial Intelligence"; first paragraph is ZERO UN INFORMATIQUE introduction]

[Text] Taking advantage of the "Avignon Days" dedicated to expert systems, the French company AMAIA [Architectures, Methods, and Applications in Advanced Data Processing] announced several products intended for artificial intelligence applications: a Lisp and Prolog machine, a symbolic workstation, and LE-Lisp language coprocessors developed by the INRIA [National Institute for Research on Data Processing and Automation].

Artificial intelligence applications which devour lines of Lisp or Prolog need specialized hardware. The Americans already have theirs: They are known as Symbolics or Explorer. Until now the French have been patiently awaiting their turn. They sometimes referred to the CNET [National Center for Telecommunications Studies] and CGE [General Electric Company] project, under development in collaboration with a company known as AMAIA, which was to lead to a machine for artificial intelligence applications (MAIA). But tangible results were sluggish.

This week the painful suspense is over. The French AMAIA company (see box) has just announced that the first European symbolic computer will become available during the summer. Its name, we might have guessed, will be MAIA.

Thanks to microprogramming MAIA has specific mechanisms that optimize the application of the Lisp and Prolog symbolic languages. The machine processes data by 40-bit words including a descriptor (8 bits are used to indicate the word type). The user has a virtual memory manager which controls a 470-megabyte high-speed disk.

The machine environment was developed in Common-Lisp, mainly in the United States. Maialog, the Prolog operating on the machine, is designed to interpret Lisp and Prolog. Thus, any Lisp statement can be inserted into a Maialog program. Conversely, Maialog can be accessed from a Lisp program. Interpreters and compilers are available for both languages.

This symbolic computer is also intended to bring artificial intelligence techniques to industry. Specifically, this step will be made possible by the availability of a VME bus. There is a close link between the Lisp tasks and the core of the system which manages bus interrupts. The activation of a Lisp task which monitors a manufacturing process can occur less than 50 microseconds (millionths of a second) after the interrupt.

Moreover, MAIA has an Ethernet-type local area network interface (TCP/IP, Telnet, FTP). Although MAIA is a single-user machine, it will eventually be used to service the symbolic requirements of several workstations.

The machine uses three dedicated and independent processors. One is dedicated to virtual memory management and controls the exchange of pages between the central memory and the disk unit. Another manages the bit-map screen (1,024 x 1,024 pixels). Finally, the symbolic processing unit (UCS) runs Lisp and Prolog programs.

MAIA's central memory can hold up to 80 Mb. The virtual memory, however, is physically located on 470-Mb disk. A memory space retriever (garbage collector) prevents memory saturation and optimizes virtual memory management, which is crucial in artificial intelligence applications in which the location rule is rarely observed.

MAIA thus seems to be well-suited for symbolic computing. There is a snag: its price, which is close to Fr 300,000. At a time when American manufacturers are lowering their prices--a Symbolics system currently costs around Fr 300,000--will the French symbolic computer not seem a little expensive?

But the offer of the AMAIA firm goes beyond the top range machine we have just studied. AMAIA has designed the Personal Symbolic Computer (PSC), a specialized workstation for artificial intelligence applications.

Supplied in the standard version with LE-Lisp and V Prolog, the PSC is listed at less than Fr 90,000. It should be noted that this machine also includes the Lispedit software development environment, which complies with the LE-Lisp 15.2 specifications defined by the INRIA.

Finally, AMAIA is planning a family of LE-Lisp coprocessors to increase the efficiency of LE-Lisp language in microcomputers. This is the CL-1000 card family, which can be installed in an IBM-PC/XT, AT, or compatible.

These cards, developed under CNET license, will be available in 1987 before the end of the summer.

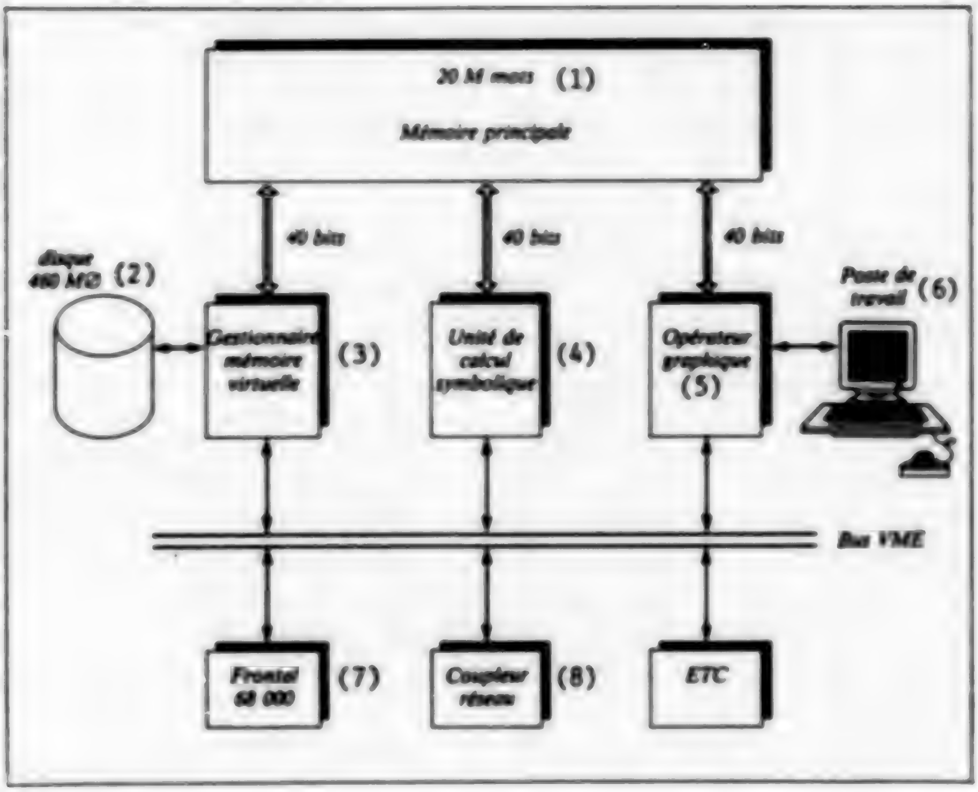
[Box, p 9]

AMAIA, a Summary

A French company created in 1984, AMAIA is managed by its founder, Pierre Stephan. Located at Bayonne and Paris, this stock company with a capital of Fr 2.5 million had a 1986 turnover of Fr 10 million. Forecasts for 1987 are

Fr 20 million, of which 40 percent will come from research activities and 60 percent from product sales. AMAIA today has 28 employees.

Graph. MAIA System Architecture



Key:

1. 20 million words
   Main memory
2. 460-Mb disk
3. Virtual memory manager
4. Symbolic processing unit
5. Graphic operator
6. Workstation
7. 68000 front-end processor
8. Network coupler

Table. CL-1000 Configurations

Features	CL-1002	CL-1004	CL-1024	CL-1028
Microprocessor	68000	68000	68020	68020
Memory capacity	2 Mb	4 Mb	4 Mb	8 Mb
Approximate price	Fr 18,000	Fr 27,000	Fr 35,000	Fr 49,000

25051
CSO: 3698/A257

GMD R&D ACHIEVEMENTS IN PARALLEL COMPUTING, COMPUTER SECURITY

Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 459-460, 20 Jul 87, pp 10-11

[Excerpts] In addition to carrying out its basic scientific work, the Society for Mathematics and Data Processing (GMD) will strengthen its position as a service center for the community in the main scientific fields. As its report on last year's scientific activity indicates, there are three primary categories involved in these additional services: research teams working on the design and development of future super-computers; universities training experts on the design of very highly integrated circuits; as well as small and medium-size companies wishing to exploit the opportunities of information technology to retain and improve their competitiveness.

The most costly of these projects is the construction, which is already underway, of an experimental laboratory for completely new computers which do not carry out one operation after another, but in which hundreds of processors work simultaneously, in parallel, on the solution of highly complex tasks. This laboratory, which until 1988 will require investments of more than DM11 million, is part of the "High Performance Computer Center for Computer-Aided Theoretical Physics and for Supercomputer Oriented Information Technology" which is being formed by the GMD, together with the nuclear research center in Juelich (KFA) and the German Electron Synchotron (DESY), in Hamburg. While the physicists in Juelich will work with a high performance computer that is commonly available on the market, the GMD will try to create the foundation for the new generation of parallel computers. This task ranges from the development of completely new computer programs (algorithms), to program languages and operation systems, and to completely new internal construction of computers which permits highly complex tasks to be "broken down" so that they can than be handled by a few hundred parallel-operating "sub-computers," whose partial solutions can be joined together for the final result.

Another GMD experimental laboratory went into operation on 1 July 1987. It deals with the control of the functional capacity of very highly integrated (VLSI) chips within the joint project "Design of Integrated Circuits (EIS)," in which 51 professors from 26 universities, and Siemens AG are cooperating, led by the GMD.

The primary goal of the EIS project is to train enough experts on the design of integrated circuits in the FRG who can follow the international trend toward the placement of more than a million circuits on a silicon surface of just 1 sq cm. Until now over 200 chips have been planned and produced within the framework of the computer project. In the VLSI experimental laboratory these chips are to be tested for universities in the future.

A complete success for both producers and clients was the GMD microcomputer center which was opened in Sankt Augustin near Berlin on 21 April 1986, where owners and workers of small and medium-sized companies in particular receive expert and objective information without obligation on the present possibilities offered by information technology for the solution of their specific operational problems. The focus of attention at the center, which is open to other groups as well, is a permanent information exhibition in which up to 20 German and foreign producers exhibit their latest microcomputers and most important computer programs.

Of all the GMD's scientific work in the past year, particular attention should be paid to two projects:

In the GMD Research Center for Innovative Computer Systems and Technology (FIRST) at Berlin Technical University a project was developed for a parallel operating computer for the PROLOG programming language to be used primarily in the field of artificial intelligence. Unlike the artificial intelligence language LISP--in which the United States has a 20-year advantage--PROLOG presents the possibility of cooperating from the start on an early project of European origin. The parallel operating PROLOG computer POPE is even more important given that in Japan PROLOG has been chosen as the basic language for "fifth generation" computer systems.

The system of electronic writing on a chip board, further developed by GMD scientists, was first of all coupled with an operational computer operational system--the BS2000 used in all Siemens commercial computers--for effective access control, which stops even the most skilled "hacker." This permits the secure identification of authorized computer users on the basis of so-called asymmetric encoding processes. Without having to register the exact identity of a user each time, it always ensures that no unauthorized person gains access to the computer, and that the computer is used by authorized people exclusively for those purposes for which they are authorized. The chip board supplants insecure access control through passowrds, as well as refined but not totally secure biometrical control through handwriting, fingerprints, or voice analysis.

8701
CSO: 3698/M402

NIXDORF HOSTS EUREKA SOFTWARE FACTORY WORKSHOP

Frankfurt EUREKA SOFTWARE FACTORY in English 1987 pp 2-4, 12-30

[Publication entitled "ESF: High Level Description of the Project and Results of the Definition Phase" issued at workshop of the ESF consortium hosted by Nixdorf in Frankfurt, FRG on 1 July 1987]

[Excerpts] Members of the ESF [EUREKA Software Factory] Control Board

France	
Bernard Lang	INRIA
Bernard Lorimy	Cap Gemini Sogeti
Hubert Tardieu	SEMA.METRA
Claude Ricaud	MATRA
Germany	
Helmut Abbenhardt	Softlab
Manfred Engl	Nixdorf
Herbert Weber	Universitaet Dortmund
Peter Winkler	AEG Software Technik
Great Britain	
Richard Thomas	International Computers Limited
Norway	
Eirik Naess-Ulseth	Center for Industrial Research
Sweden	
Conny Bjoerkvall	TeleLOGIC
Spain	
Hubert Tardieu	SOFEMASA

Introduction

The project aims at providing an ESF which is both capable of being configured for specific industries and of evolving with the innovation which arise from worldwide research. This will be achieved by providing a reference architecture for the dual purposes of tailoring and evolution. It is recognised that many applicable technology advances will occur over the life

of the ESF. Examples of these areas of technology are: Formalisms, knowledge engineering, artificial intelligence (AI), parallelism, architectures, declarative systems. The open architecture will support an evolutionary exploitation of these technologies on a broad, parallel base.

The architecture will also support the movement in software engineering from existing support environments towards industrialisation and automation of the software production process. Modelling of processes and human activities will be an essential part of industrialisation, leading to the use of mixed paradigms based on advanced system analysis techniques, descriptive and modelling languages, rule based techniques and AI. As in most industrial processes, the idea of re-usable components is paramount to acceptable levels of productivity.

Fundamental to these aims is the need for comprehensive, evolving integration mechanisms. These will function at an external level to support processes methods and roles. They must additionally function internally to support object management, interoperability between tools to increasingly fine levels of granularity.

Our long term vision might be towards a knowledge assisted, configurable system capable of directly solving the "user problem" presented to it.

That is very much a vision of the future. The remainder of this technical chapter will describe the architecture and the technologies which are available in the medium terms.

The ESF project has chosen to propose a number of concepts for a software factory and to develop an architecture for a software factory. We will then evaluate those concepts and the proposed architecture by stating the principal goals expected to be achieved with ESF and by comparing them with the goals to be achieved in other SPE [software production environments] projects. The result of this evaluation will provide an answer to the question "what is specific about ESF and what distinguishes ESF from other related concepts."

An architecture for ESF will then be described. Since ESF is not meant to be one single product, but a variety of products that conform to a reference model, the architecture as it is presented here is called a reference architecture for ESF. The explanation of that reference architecture will then give rise to the explanation of how a particular ESF may be built that conforms to this reference architecture.

A delivered software factory that conforms to the reference architecture is called an instance of the ESF. Knowledge of this architecture will help suppliers to provide components that can be integrated in an ESF instance. The technical foundation for producing an instance of ESF has been analyzed in the definition phase and will be described. The interconnection of existing

components of ESF is equally important. As tool suppliers may only want to develop tools for particular tasks in the software development process, they must be aware of the constraints that exist for the interconnection of those tools to ESF and for the interoperability of those tools in the framework of ESF. The development of concepts that support the interconnection and the interoperability will therefore be explained.

The term "Software Factory" points to a system that supports software development for many different application domains and for many different organizational environments.

Moreover, a software factory is intended to support the entire process of industrial software production through proper tools. It is the intention to minimize the initial investment needed to develop ESF by adopting an incremental approach within the given reference model.

How add-on's and replacements may be furnished will also be part of this technical explanation. These explanations altogether will serve in answering the question "how can a tool be integrated to an ESF instance, i.e. how can it be plugged into an ESF instance."

The ESF Specifics

The Method Integration Support

In order to achieve the highest possible degree of automation of the software production ESF is striving for a higher degree of integration than the one achieved through the prescription of the tool activation in accordance to a proper model of the production process. It is seen to be essential in the ESF to really make different tools to interoperate by integrating the methods they individually support into one coherent process that supports the software production at all of its stages.

In order to achieve this goal a coherent methodology is needed that permits to describe precisely the just mentioned coherent process. This is done by precisely defining the relationships between the functional specification in some notation and the design in some other notation.

Software Production for re-use of software components

The lack of productivity in today's software development practice has been acclaimed since a long time. Various attempts and measures to increase the productivity by orders of magnitude have not been successful so far. A still promising concept to enable more than only marginal improvements of the productivity is based on the idea of a heavy re-use of prefabricated components. The popular term frequently used is "software components from the shelf" and hints at the same parts and components market that exists in many

other engineering fields.

This kind of a software parts / components market is far from being existent. For its development software components must be specified to fulfill precise requirements and thus have a precisely defined "functionality." The development of those software property specifications largely depend upon the existence of formal specification techniques with whom one may fully specify all the outside observable properties of those components.

In addition to the appropriate specification techniques, tools are needed to store re-usable components, to search for re-usable components in the store on the basis of the properties descriptions for components and to validate and verify the interoperability of components. To provide those tools is then also essential in a software factory. The ESF project has choosen to develop the EUREKA Software Factory - for the benefits expected from the re-use of components - as a factory that supports the re-use of components in the production of software to the utmost extent. The ESF itself will be a sample system that will be heavily constructed of such re-usable components. Only with the re-use of components and with proper provision for the interconnection of prefabricated components the ESF project will be able to achieve its goal to provide the aforementioned "plug in" capabilities, the "extension" capabilities and the "openness" property.

Intelligent Process Support

The software production process that structures and coordinates the work of many software developers in a division of labour mode, for software developers that may be geographically dispersed and for the development of large software systems, is very complex and hard to control. Both the production management as well as the individual software developers need continuous guidance in their work.

ESF will provide a framework for intelligent support of the software production process through an active process description based on the role concept. As explained in the following section in more detail an instance of ESF may be tailored to company project or application specific needs by refining or extending the generic model. It may also be possible for users to tailor their proper sub-models, if this is allowed in the actual ESF instance.

The support, model based intelligent help mechanisms and the tailorisation mechanism itself may all benefit from expert system or other AI techniques.

ESF Reference Model and Instances

The services provided by the components ESF User Interaction Services (ESF-UIS), ESF Object Storage Services (ESF-OSS), Factory Control and their interrelation using certain communication mechanisms form the so-called ESF-

support. The ESF-support is the only interface between an existing operating system and the individual tools.

The ESF-OSS provides a common interface to store and retrieve units and relations between units in a data repository (or global storage). Any other component uses that interface if it uses the data information. Shortly, the ESF-OSS realizes the ESF data model. However, this does not imply that the implementation of this interface has to be done by building a special ESF-OMS (or ESF-Object Management Systems in other words). This implementation could also be done by building adapters, i.e. existing storage services (such as e.g. PCTE) could be used within an ESF instance by implementing the ESF-storage service interface on top of the operations of an existing storage service.

The central aim of the ESF-Object Storage Service is to achieve the internal data flow integration of tools by using global storage.

Very similiar to the ESF-OSS, the ESF User Interaction Service (ESF-UIS) provides a common interface for the man-machine dialogue within ESF. Any other component uses the operations of this interface for reading user input or presenting information to the user on some output device (screen, printer, etc...). Operations which are provided by this interface handle, for example, window management which includes the manipulation of special purpose windows such as forms or menus. However, this does not imply that the implementation of this interface has to be done by building a special ESF-UIS. It could also be done by building adapters to existing window or I/O systems for printers, etc, i.e. existing I/O systems could also be used within an ESF instance. Of course, such an interface must be easily extensible. Then it is possible to add more sophisticated I/O devices later which allow e.g. speech I/O.

The central aim of the ESF user service is to achieve the external integration of tools.

Basic techniques are offered within ESF to realize communication between the single components. The so-called Communication Mechanisms include the use of the data repository, i.e. the ESF-OSS as one possibility for communication whereas the others are summarized by the term point to point connection.

One possibility of point to point connection is the transformation of data such that the output of a certain tool can be used as input of another tool.

Another aspect of communication mechanism existing in ESF deals with control flow integration of tools. This mechanism is necessary to realize the use-relation between object. Such a use-relation, i.e. the use of an interface operation of one object within the implementation of another object can be implemented in many different ways depending on what machines the different objects are available. For example, if the ESF-OSS and a certain tool are

running on different machines communication has to be implemented by using a certain network together with a corresponding protocol. If the ESF-OSS and the tool run on the same machine a communication can probably be implemented by using a simple procedure call.

Tools, an ESF instance consists of, can be integrated technically based on the components explained so far which are: ESF-OSS, ESF-UIS and the software busses for point to point connection.

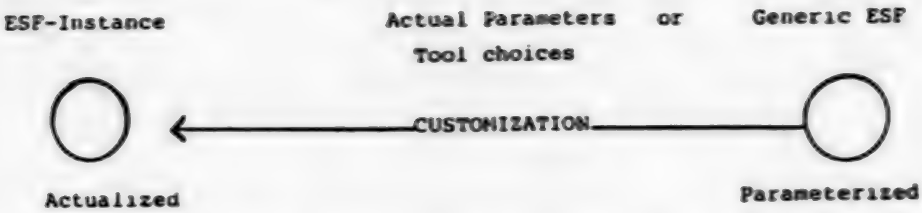
So far, we have not explained any component which provides monitoring of the different tools within one instance. This includes to allow the use of different tools only in a certain order or by special users which have the access right to these tools. For example, certain user roles such as a project manager, designer, implementor or secretary are combined with the use of certain tools and restrain access rights, i.e. a project manager is only allowed to use management information tools, an implementor uses only editors and compilers, the secretary uses only an editor and the mail system. Furthermore, tool dependencies such as a compiler can only be invoked when a source code was already built by using a syntax-directed editor. A certain order of tool activations updating of all project management information in all documents of informing all team members about changes of the design. All these dependencies are implemented and thereby monitored by the component Factory Control which includes all the Control Mechanisms existing in an ESF instance.

The ESF project is not aiming at the development of an ESF as one invariant software factory but rather at the development of a framework for many different, and maybe changing, architectures. Consequently, we do not develop the schema for the ESF architecture but rather a reference model of that architecture that embodies possibly different concepts and components. Any existing factory is then called an ESF instance if its design matches the reference architecture. The single components of the reference architecture are described in more detail in the next section.

In addition to the reference architecture, ESF wants to provide much more detailed concepts for the configuration of an ESF instance. The two orthogonal concepts used in such a configuration process are called customization and implementation and will be explained in more detail now.

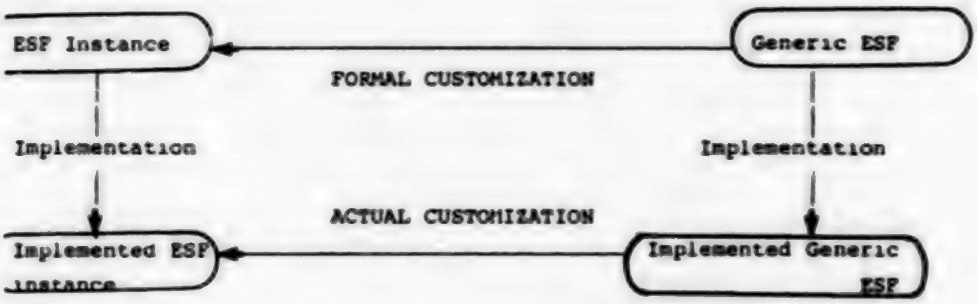
Customization refers to two possibilities in configurating an ESF instance, (i.e. creating an ESF instance including all the tools in that particular instance as well as the control of mechanisms for these tools):
(1) The selection of existing appropriate tools such that the resulting instance fulfills a particular kind of need and requirements given for a special instanciation and
(2) The actualisation of formal parameters when using generic tools.

The following figure depicts the customization on the conceptual level



The above given figure describes a general model how an ESF instance relates to generic ESF. The customization depicted above refers to the mapping between the two models. We, therefore, call it formal customization.

Implementations correspond to both models, the generic ESF as well as an ESF instance.



The formal customization existing between the models of the generic ESF and an ESF instance corresponds now to an actual customization between an implemented generic ESF and an implemented ESF instance.

It is important now for the application of the instantiation concept to provide answers to the following questions:

1. How do we arrive at a generic ESF (i.e. a model/a conceptual schema of the generic ESF)?
2. How do we arrive at an implemented generic ESF?
3. How do we arrive at an ESF instance and
   How do we arrive at an implemented ESF instance?

We will be answering these questions now in the above order:

1. The ESF project is aiming at the development of the model of a generic ESF on the basis of the accumulated knowledge and experience of the ESF partners about the production processes that must be supported for the production of different kinds of software (e.g. commercial software,

distributed systems software, real-time software) and for different organizational environments (e.g. hardware manufacturers, software houses, system houses).

2. The implementation of the generic ESF will be achieved by a selection of tools that are seen to be supporting in the production process as defined above. The selection may be a selection from the market of existing tools or may be a selection from the wide range of tools to be developed. The generic nature of the implemented generic ESF - either selected or developed - will be established through provisions for parameterization. On the basis of this parameterization concept the implemented generic ESF may be used to derive an implemented ESF instance. In order to enable the derivation of implemented ESF instances, the implemented generic ESF must provide the aforementioned actualisation capabilities or even generation capabilities.

3. Since the generic ESF and the implemented generic ESF both provide actualization or generation capabilities, an ESF instance and an implemented ESF instance can be derived through the application of these mechanisms or through additional manual tailoring.

   For the support of the customization process the ESF project will identify - and possibly develop - tools that enable a "mechanisation" of that customization process. At both the model level and the implementation level a "mechanization" may be achieved with tools for the validation and conformance testing. Those tools are meant to aid in the process of ascertaining that an ESF instance is in conformance with the generic ESF or that an implemented ESF instance is a conformance with the implemented generic ESF.

In a more advanced ESF instance smarter techniques could be applied to provide a more powerful factory control. The idea of a rule based expert system could be introduced to provide more sophisticated user support, i.e. the factory control does not only monitor the correct use of tools (as described above) but would support a user in choosing the appropriate tools to fulfill his task which he wants to carry out or would even trigger the execution of certain tasks by itself without being triggered by corresponding user command. Furthermore, certain user profiles as e.g. novice, advanced, experienced could be described using the notion of facts and rules and thus a profile could thereby dynamically change when a certain user is actually using the factory. In this way it is possible to realize the automatic adapatation of the external behaviour of the factory to the knowledge of a certain user. Shortly one can say that such a factory would not only react, i.e. carries out user's commands, but gives active support during the software development process.

ESF standards to be developed

The description of the reference architecture already gives limits which interfaces should be standardized within ESF. This is first of all the definition of ESF-OSS (ESF Object Storage Services) and ESF-UIS (ESF User Interaction Services). Furthermore, a common method should be used to describe tool interfaces such that the implementation of tool dependencies (i.e. the implementation of tasks, user roles, etc) becomes more convenient. In particular, this would facilitate the integration of new tools as well.

Furthermore, the software busses realizing point to point connection can also lead to standardizations in the sense that special software busses for special requirements exist. To clarify it by a real world example: software busses could be available as adapters in electrical engineering and be taken off the shelf when needed. Then, a special description method for software buses should be defined which enable to find quickly the appropriate bus on the shelf. Software busses will provide the plug-in capability and assure the proper interaction of tools.

Overview Over the Technical Work Performed During Definition Phase

Working Group I

The objective of the Working Group 1 (WG 1) was to study the scenarios of software production in the industrial environment in order to provide a framework for a more complete analysis of the requirements for ESF.

As a first step, information from a number of different areas was put together and analysed with respect to the current situation, the influence from emerging techniques and possible future evolution. The choice of application areas was primarily guided by the current market situation, but also to some extent by the expertise available within the consortium (e.g. AI software was studied despite its marginal market share). The result of this analysis was a list of basic characteristics for each application area.

In the second step, a global analysis of the characteristics led to a separation of common and specific features, which in their turn suggested some common and specific needs for support that should be provided from ESF. These results are presented in the WG I report in the form of:
--A matrix of common needs versus application with specific attributes for some areas indicating any particular characteristics
--A list of specific needs per application area.

The following application areas were included in the work:
--Commercial and common business
--Telecommunication
--Real time and embedded systems

--Computer aided systems (CAD, CAM,...)
--Numerical applications
--Artificial intelligence

but only the first five were studied in full detail.

The major common needs that are listed in the report are:
--Software quality assurance support
--Project management support
--Documentation and configuration management support
--Support for distributed development
--Support for host/target development
--Reusability support
--Maintenance and error handling support
--Graphical user interaction

Working Group 2

The objective of the Working Group 2 was to review possible and applicable techniques to be used in the development of ESF. As a result of this work, a report describes the state of the art and the technical conclusions of how the construction of ESF could benefit from some different techniques.

The techniques included in the review are:
--Object oriented approach to design and programming
--Object centered information management systems
--Man machine interaction
--Software bus
--Rule based systems
--Validation and verification techniques

Based on individual contributions, each topic has been reviewed by a subgroup in order to come to common understandings of the concepts involved. The final report includes both the individual contributions and a synthesis part produced by the working group.

The main work has been done on object oriented approach, object management systems, man machine interfaces and software busses. A common agreement has been reached on two important conclusions:
--An object oriented approach to design and programming seems to be a suitable technique to be used in the ESF architecture
--All components of ESF must be designed to be independent of their user interface.

As an example of how state of the art techniques may be applied, an experimental system for software development which is developed by S.I.

(Norway) has been studied and described.

Working Group 3

The objective of the Working Group 3 was to determine the global requirements of ESF and to produce a list of these, indicating both priorities and the origin of each particular requirement:

--By studying the software production process from the point of view of the people involved in the process

--By studying the strategic goals which have been set up for ESF, like better productivity, better quality, higher flexibility etc..

--By analysing the common needs that were expressed as a result from WG 1.

The first study is based on a role model of the software production process where the role concept is an abstraction for the people involved (a particular person may play several roles and vice versa, a particular role may be played by several persons). The role model has been set up to include not only technical roles but extends the domain to include project manager, higher level management, administrative staff and even the client.

As a first step in the analysis of the strategic goals the group worked out a common understanding of the meaning of each goal. Then the goals were analysed in a top down manner in order to make explicit the necessary means for achieving them. Many of the needs expressed in the WG1 results were actually covered by this work.

The remaining needs in the WG1 results (e.g. support for distributed development, which was not derived directly from the strategic goals) were further analysed.

As a common result from the subgroups a requirements data base has been built. Requirements are expressed as statements in natural language with attributes indicating their priorities, their origin and an assumed impact on ESF. From the data base requirements may be extracted and sorted according to these attributes (e.g. list all requirements originating from the needs of the project manager role).

Working Group 4

The objective of the Working Group 4 was to provide an outline for the architecture of ESF, taking into consideration the requirements expressed in the WG1 and WG3 reports where necessary and applying the techniques that were recommended by the WG2. In addition to this, the concepts of generic ESF vs. instances of ESF should be studied and defined, and the process of instantiation should be described.

The results of WG4 are described in a report comprising the following parts:
--A conceptual view of the architecture of an ESF instance (i.e. an installation of ESF) describing the main components and their functionality
--A description of tool interaction and different types of integration that should be expected e.g. data integration, user level integration etc..
--The applicability of object orientation to designing the architecture described under the first part
--A more detailed description of the components of the architecture
--The generation and tailoring of ESF instances using a conceptual schema describing the generic ESF.

Working Group 5

The objective of the Working Group 5 was to evaluate existing and proposed software production environments (SPEs) and tools, in terms of
--Facilities offered
--Techniques used
--Architecture and design
--Standards used or proposed
and to establish the evaluation criteria for further studies.

Information regarding a total of about 60 relevant projects (half of which in the ESPRIT programme) have been collected. Short descriptions of the main projects and references have been compiled into the WG5 report. Most of the projects are relevant primarily from a technical point of view and only a few of them have the intention, and the political power, to propose standards for SPEs. These projects which are all major efforts have been studied in more detail (where any details are actually available to be studied):
--PCTE
--CAIS
--PACT
(no detailed technical information available)
--SIGMA
(no detailed technical information available)
emerging proposed standards in graphical user interface subsystems (e.g. X windows, PCTE user interface, Macintosh, NeWS) and object centered data bases (e.g. PCTE/OMS, PVS (POINTE)

Three other Working Groups are still active:

Working Group 6

Based on a paper prototype, the ESF support described in the WG4 report will be validated.

Working Group 7

A proposal for the project organisation and for the detailed workplan for phase 1 will be presented.

Working Group 8

The requirements listed by WG3 will be studied in more detail concerning completeness and consistency.

The coverage of these requirements (specialized to one application situation) by the prototype of WG6 will be considered.

Conclusions

ESF provides a new approach to build software factories. Software factories differ from software production environments in that they heavily emphasize on industrialization and automation of the software production.

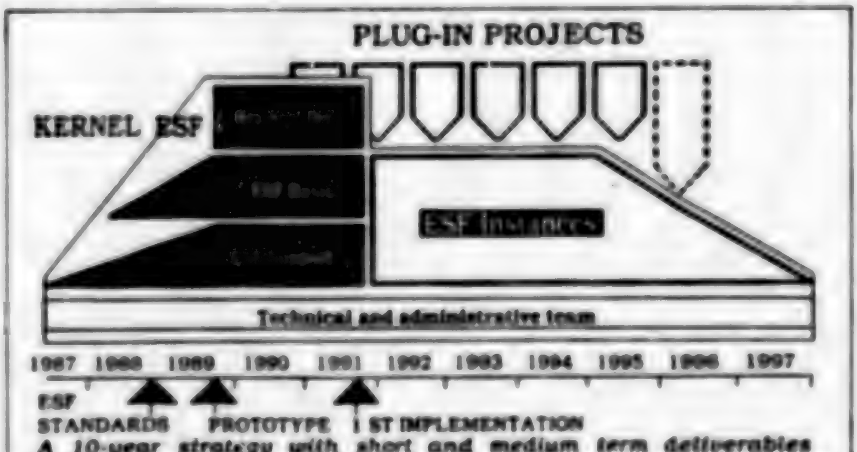
ESF in particular provides a reference model which allows to derive ESF instances. This enables to tailor a factory towards the specific needs and requirments of one company.

The power of the integration mechanism provided by ESF together with the standardization of interfaces permits the reuse of components.

The systematic use of the role model in ESF permits a comprehensive description of different structured models for the software production process.

This formal description of models for the software production process can be used as basis for expert systems which support the user in following his software production model.

A 10-year stategy with short and medium term deliverables:



A 10-year strategy with short and medium term deliverables

8700
CSO: 3698/M443

MORE MANEUVERABILITY, LIFTING CAPACITY WITH ASEA IRB3000 ROBOT

36980004 Paris ELECTRONIQUE INDUSTRIELLE in French 1 Sep 87 pp 25-26

[Article by Jean Bladou]

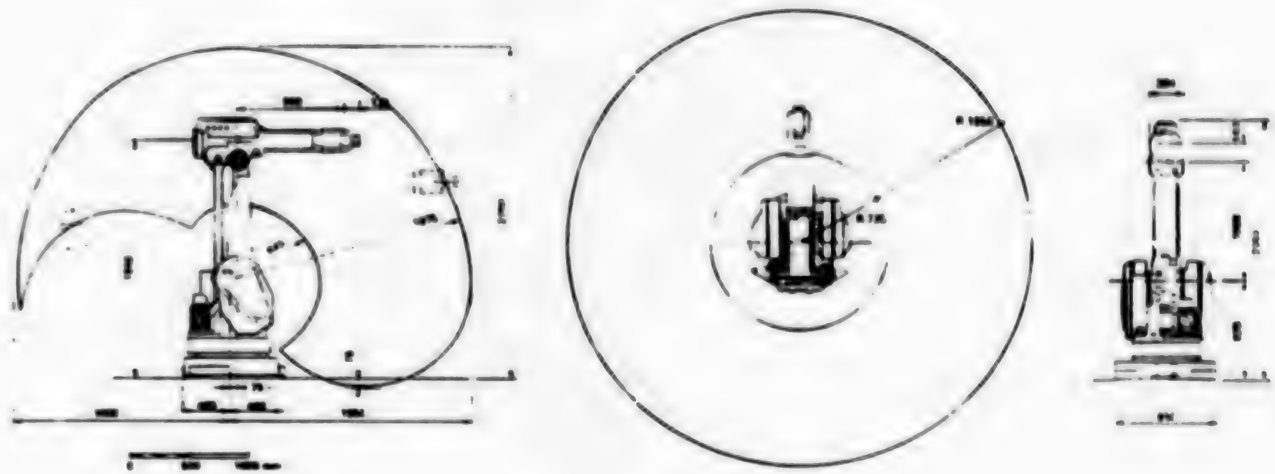
[Excerpts] The IRB-3000 is the second member of the new generation of ASEA robots. In a way, it is the big brother of the IRB-2000, although younger. Viewed from the standpoint of aspect alone, the two robots appear identical, except for size. In reality, the essential difference lies specifically in their respective lifting capacities, which in the case of the IRB-3000 has been increased to 30 kg; but the technologies used in both are identical.

The machine is a 6-axis robot, featuring an extended working span, hence well-suited to applications such as water-jet cutting, laser cutting, and spot welding. But primarily, this robot is designed for materials-handling and machine-tool-serving applications. Its speed and accuracy characteristics also permit its use in assembly operations.

To begin with, its axis-1 angle of rotation is more or less 180° at a maximum speed of 106° per second. Its other characteristics of freedom and speed are: For axis 2 (arm): +90° to -110°, at 100° per second; for axis 3 (upper arm): from +60° to -60°, at 87° per second; for axis 4 (wrist rotation): 200° in each direction, at 223° per second; for axis 5 (bending): 120° in each direction, at 224° per second; and for axis 6 (twisting): more or less 250°, at 213° per second. Its repeatability throughout is accurate to within ±0.15 mm.

From a rigorous "mathematical" viewpoint, these characteristics are perhaps not very meaningful, except to particularly knowledgeable specialists. Furthermore--and this should awaken the interest of those responsible for materials handling--this robot is capable of simultaneously serving two Europallets (800 X 1200 mm) placed side by side either along their respective lengths or respective widths.

Its most extended zone of maneuverability is situated at a height of 1 meter from the floor; that is, at the normal height of loading/unloading stations and conveyors.



Maneuvering envelope of the IRB-3000.

Different assembly configurations are offered as options, and in particular that of the inverted position. In this configuration, the upper arm can be lifted very high, thus allowing greater freedom for the lower arm, and enabling the completing of full revolutions without difficulty.

Its 30-kg lifting capacity was not arrived at by chance. The fact is that the average weight of machine-tooled pieces is kept, to the extent possible, at a maximum of 10 to 15 kg, so that they can be relatively easily handled by a human operator. Thus, if the arm is equipped with a dual gripper, it can handle two pieces at a time, resulting in an appreciable time gain.

On the other hand, if its installation is to be made simple, its control system must be capable of communicating with all the equipment the robot is intended to serve.

The control system of the IRB-3000 is equipped with the most widely-used series and parallel communications interfaces, enabling it to dialogue with the vast majority of numerical controls on the market, using a very simple protocol. In addition to these communications ports, the control bay has 64 numerical input and 64 output terminals, as well as 4 analog inputs and 4 outputs. The robot can thus be put to work in a very complete environment of sensors and actuators. At any given instant, the bay can contain a principal program and 9999 subprograms. Its memory capacity is 64 K-octets [K eight-bit bytes]. A total of 2,500 positions or numbers can be recorded. A battery power pack provides backup for a minimum period of 1,000 hours.

Certain software functions are integrated, such as tool coordinates, palletization functions, overload tests, alignment functions for the multiple grippers, provision for programming eight grippers, and management of the compressed air and electric power supplies.

Numerous peripherals have been developed for materials-handling and machine-service applications. These include tool changers, tool holders, and grippers... It should be noted also that the air and electric power supplies are available all the way up to the pincers.

Thus, what the Swedes are offering is not only a new robot, but actually a coherent line of robotization equipment.

9399

BRIEFS

ESPRIT MANUFACTURING COMMUNICATIONS NETWORK -- After a 2-year research effort, the first real-scale application of the ESPRIT-CNMA (Communication Network for Manufacturing Applications) research project was presented at Hannover, FRG. The acronym stands for the European version of the MAP "Automated Factory" protocol, an industrial communication standard which has been under development since the early 1980's by a pool of major manufacturers led by General Motors. The application on display in Hannover integrates a computer, a continuous path numerical control machining center, a pair of tool loading and unloading robots, and a pallet transport system, all of which "speak" to one another through a local communication network. Thirteen European companies, selected among the leading manufacturers and users of automation systems, contributed to the implementation of the first stage of the project. These companies include Britain's British Aerospace, which leads the consortium; Italy's Aeritalia and Olivetti; the French companies Bull, Elf, and PSA; and the FRG's Nixdorf, Siemens, and BMW. The first machining cells are to be installed in British Aerospace's Wolverhampton plants, for the production of aircraft components, and in Aeritalia's Pomigliano d'Arco factories, where they are to be used for marking the cables installed on the Airbus 320. The subsequent phases of the project have been scheduled in such a way as to enable the partners to gain the technological know-how required to tie in with the implementation of the MAP 3.0, that is, when the U.S. protocol is completely defined by General Motors. [Text] [Rome SCIENZA DUEMILA in Italian No 8, Aug 87 p 87] 8628

CSO: 3698/M410

ASEA OF SWEDEN COMBINES HIP, POWDER METALLURGY IN NEW PROCESS

Vasteras ASEA TIDNING in Swedish No3-4, 1987 pp 12-17

[Article by Bjorn Barnheim]

[Excerpts] Asea Powdermet of Surahammar has developed a new technique for producing molded goods of stainless and high-temperature steels and of so-called superalloys on the industrial scale. The company has developed a method of producing high-quality materials using powder metallurgy and hot isostatic pressing (HIP). This new technique opens up new opportunities for applications in the manufacturing industries that were previously unprofitable or even impossible.

Asea Powdermet's new technique also opens up previously undreamed-of opportunities for creating totally new solutions in materials technology by combining powder of one kind with powder of another kind or powder with a solid alloy that is produced in a conventional manner. In this way, layers with totally different properties can be built into various parts of a molded product. This compound technique has great possibilities.

Asea Powdermet's new technology is extremely well suited for applications that require advanced materials with high performance characteristics.

Unprecedented

Many of the new alloys that are produced by the new method have no counterpart among conventional special steels when it comes to their properties. They are often extremely difficult to produce by conventional methods, as well.

One example of this is a high-strength stainless ferritic-austenitic steel called APM 2389. It is highly resistant to corrosion, such as stress corrosion and pitting corrosion. Its corrosion resistance is just as high as that of the "best" conventional ferritic-austenitic steels, but the yield strength of APM 2389 is far greater than that of other types of steel with similar corrosion resistance.

By using powder metallurgy and hot isostatic pressing, APM 2389 can be given a high nitrogen content. This provides a yield strength of at least 600 N/mm^2, which is quite high for hardened ferritic-austenitic steel.

The material is patented and, after extensive testing, it is now being series produced for various applications. Over 50 products weighing 30 to 500 kg each have been produced commercially from APM 2389.

Results With 12-Percent Chromium Steel

Another example is a 12-percent chromium steel, APM 2390-3, a high-temperature material for the turbine industry.

A large number of rings of this material, about 400, have been produced for Asea Stal. Extensive testing has shown that this material possesses greater toughness than that of conventional materials.

Impact strength values up to 100 J can be produced by properly controlling the process. This creates significant potential for increasing the yield strength.

High-cycle fatigue in the form of pulverizing tensile tests on a large number of test rods showed that the fatigue limit of the HIP product, 10^7 loading cycles, is 20 percent higher than that of the conventionally produced material.

Creep resistance is of the greatest importance to the functioning of the material. Creep tests were conducted at 550 and 600°C. The HIP steel clearly has greater creep resistance.

Ultramodern Production Facility

Asea has built an advanced facility in Surahammar. In addition to skilled personnel, there is now an ultramodern plant for the totally integrated production of powder metallurgy products. This is an advanced process.

The material is melted in a high-frequency furnace that has a capacity of 2.5 tons. The composition of the melt is monitored by taking preliminary samples. The composition is adjusted by adding the required alloy elements in a special ladle with a controlled atmosphere.

The liquid steel is then allowed to flow down into an atomizing chamber. A stream of gas meets the steel at a right angle and "breaks up" the liquid steel, forming small drops. The atomization occurs with an extremely low oxygen content in the chamber in order to avoid surface oxidation of the drops.

Rapid Cooling

The drops are cooled at a rate of about 1,000 degrees per second. This limits the solidification reactions that normally occur in a casting, where the cooling time is quite long. Each grain of powder has the same chemical composition as the melt. In addition, an extremely fine crystalline structure is produced by the rapid cooling.

In this way, a material made of powder is completely free of macrosegregations and, in most cases, it is also free of microsegregations. This makes it highly homogeneous. In addition, the material is completely isotropic, i.e. it has identical mechanical properties in all directions.

The powder that is formed is collected in the bottom of the chamber. The grain size varies and before it is poured into closed containers it is screened to 0.5 mm. The mold is then filled with a powder of the alloy in question, the air is evacuated, and the mold is closed.

Free Of Residual Porosity

The mold is then placed into the press (a high-pressure furnace, for example), where it is subjected to high temperature and pressure. The material is then compressed by hot argon gas under high pressure, which acts uniformly from all directions on the mold. The mold shrinks uniformly by 10 to 12 percent in all directions due to plastic deformation of the powder grains.

A material that is produced from gas-atomized powder by hot isostatic pressing is completely air-tight, i.e. all porosity is eliminated. During compression, the surfaces of the powder are bonded together.

Because of the high temperatures that are produced during pressing, metal atoms migrate across the boundaries between powder grains. In this way, the forces and the bonds between metal atoms on both sides of the boundary are the same as they are within a powder grain.

The pressing is carried out in the world's largest hot isostatic press, an Asea Quintus press. It has a diameter of 1,470 mm and the volume of its furnace is about 5,000 liters. The maximum temperature is 1,250 degrees Celsius and the maximum pressure is 140 MPa (1,400 bar).

Adjustment

The temperature during pressing is well below the melting point of the material but, at the same time, it is sufficiently high for the powder grains to become plastic and deformed under the influence of the pressure. A lower temperature and a longer pressing time are chosen if the fine crystalline structure of the powder grains must be retained. In this case, there is time for atomic bonding to occur through diffusion across powder grain boundaries.

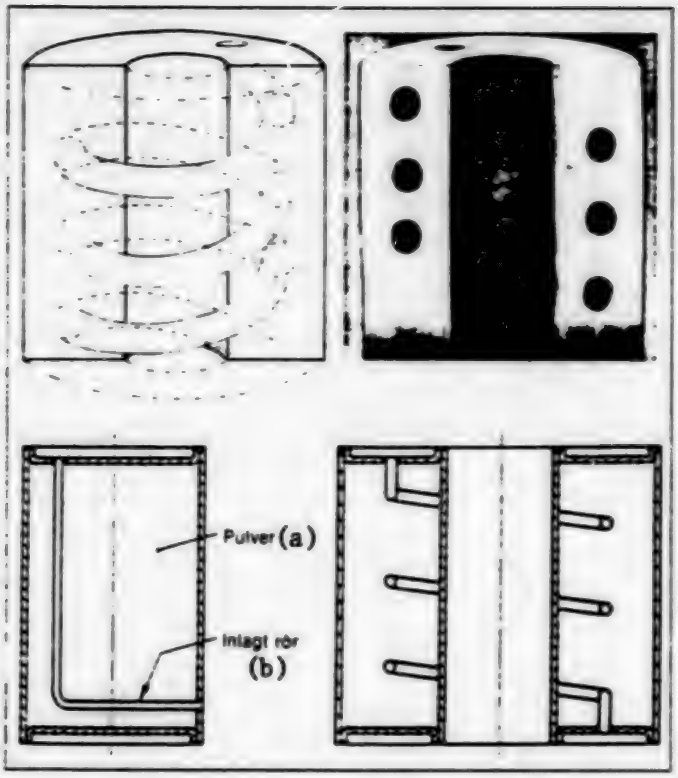


Figure. With powder technology it is possible to create products in almost completed form and to insert channels, for example, into the molded product.

Key:

a. Powder
b. Inserted tube

9336
CSO: 3698/616

SIEMENS, PHILIPS JOIN FORCES IN INTEGRATED SEMICONDUCTOR FIELD

Siemens-Philips Megachip Project

Duesseldorf VDI-NACHRICHTEN in German No 28, 10 Jul 87 p 1

[Text] VDI.N Eindhoven, 10.17.87--After about 3 years the joint Siemens-Philips Megachip project has this year achieved two considerable successes. After Siemens presented the first 4-Mbit memory to the public in March, the Netherlands partner, Philips, introduced the world's first 1-Mbit SRAM (Static Random Access Memory) last Thursday.

The joint project absorbs 40 percent of the two companies' annual research budget. The SRAM project is subsidized by approximately DM450 million from the German and Dutch governments.

The 90 mm 1-Mbit SRAM chip will go into mass production in mid-1989. For this purpose, Philips will open one of the largest European production centers for semiconductors with extremely small micrometer structure, at the end of this year in Nijmegen, the Netherlands.

The first coaster-sized silicon chip with static memory was presented to Netherlands Economics Minister de Korte on 30 June. To the minister, the integrated semiconductor component represents a milestone for the joint megachip project. However, in his view, the project is just one important step, although a special one for the Netherlands. He hopes for greater international cooperation. All members of the European Community should take part in research programs proposed by the EC-Commission. This includes existing programs such as ESPRIT and RACE which complement the Megachip project, and in which Siemens and Philips are cooperating more frequently.

Philips SRAM Unveiled

Duesseldorf VDI-NACHRICHTEN in German No 28, 10 Jul 87 p 2

[Excerpts] George van Houten, a member of the Philips board of directors in Eindhoven, presented the latest component under the motto "the state of the art in submicrometer structure within integrated circuit technology." The newly unveiled 1 Mbit SRAM is based completely on CMOS technology. As van Houten reported, it is characterised by low energy consumption and has an access time of only 25 nanoseconds, thus acquiring a leading role internationally.

According to the Philips managers, the 1-Mbit SRAM was presented at exactly the right time. Although at present there is no concrete need for it, a large number of semiconductors with extremely fine micrometer structure will be required in the 1990's.

The Dutch expect a growing demand--especially in the consumer goods industry--for digital switching circuits, an area in which Philips is involved worldwide. The company predicts future applications, for example, in digital television sets.

However, the static memory could also be used in automobile electronics, data processing, and in communications systems. According to the producers, the component is destined for portable battery-operated appliances due to its low energy consumption.

Besides acquiring actual know how on a difficult production technique, Philips mostly hopes to have an advantage in producing consumer goods.

To van Houten, the growing number of functions on a chip will both encourage the application of advanced production techniques for minute structures and increase production. Van Houten also reported that this development led to large price reductions in this field in the past, as the Japanese continue to prove. The Dutch, also, clearly aim at low prices, which should support SRAM considerably.

With regard to the world market and the newly established position of his company, van Houten self-confidently rejects dumping. "That includes Japan. To guarantee fair prices, free trade must take place on a fair basis."

From ninth place among international large integrated circuit (IC) developers, over the last 2 years the company has worked its way up to the middle of the top ten with an 8 percent share [in the market.]

Even though the production of integrated semiconductors in the United States is constantly losing ground, it was the strong Japanese competition which led to Philips comprehensive, government [sanctioned] cooperation with Siemens. There is an active exchange of information in all sub-projects such as CAD-instruments, memory design, and production know-how, confirmed Hans Friedrich, the senior director of Siemens AG in Eindhoven. However, at the end of the 1980's the status of this cooperation in the actual production stage of integrated semiconductor components is still unclear, but it is already being discussed.

8701
CSO: 3698/M397

SIEMENS, ICL, THOMSON DEVELOPING CAD SYSTEM FOR CIRCUIT DESIGN

Rome SCIENZA DUEMILA in Italian No 8, Aug 87 p 87

[Text] In the framework of the ESPRIT program, Siemens, ICL, and Thomson have started a joint research and development program known as AIDA (Advanced Integrated Circuits Design Aids). The project, which is to be implemented under the guidance of Siemens, is expected to develop new designing methods and new CAD (Computer Aided Design) instruments to be used in the production of VLSI (Very Large Scale Integration) circuits, characterized by more than 1 million transistor functions. The project, for which some DM74 million (33 million ECU) have been allocated, is expected to take 4 years to implement and to require a total number of work hours amounting to 300 man-years.

With the current designing systems, manufacturers have succeeded in producing integrated circuits with semiconductors having more than 100,000 transistor functions; however, these systems are inadequate where circuitry involving 1 million functions is required. It is thought that new technologies will be developed over the next 5-10 years that will offer the ability to place several million transistor functions on a single design as well as new instruments for designing complex, future-generation logic circuits.

The AIDA project, which is being carried out by Siemens, ICL, and Thomson, is subdivided into the following sectors: logic and electrical synthesis (silicon compilation), testing, data maintenance management, layout, and user interface. The operations to be performed in each of these sectors have also been subdivided in the project, so that each company may contribute according to its know-how and equipment. Siemens is responsible for the layout and test sectors; Thomson is in charge of logic and electrical synthesis and of user interface; and ICL coordinates work in the area of data maintenance and management and of systems specifications. Inasmuch as it is the project leader, Siemens is responsible for the coordination of the various operations, including those carried out by the universities of Manchester, Grenoble, and the Bull Research Center in Paris.

The Siemens team which is to engage in the AIDA project will include more than 30 development specialists who are to work in the Perlach

research lab. Siemens will introduce all new developments into its Venus design system. The project leader is Dr Knut Merten who was previously responsible for all CAD developments achieved in the framework of the Venus system.

8628
CSO: 3698/M411

FRANCE RESEARCHFS 3D IC'S WITHIN ESPRIT PROGRAM

Paris MICRO-SYSTEMES in French Jun 87 pp 91-98

[Excerpts] Electronic circuit manufacturing techniques have been improved ceaselessly, thus permitting the integration of an ever larger number of designs for ever smaller dimensions. However, certain factors involving specifically the dimension of connections limit the advantages introduced by integration. Stepped-up efforts over the past several years are aimed at putting together vertically integrated structures, more commonly referred to as integrated 3D circuits. This method of integration offers the possibility of having a larger number of shorter and more reliable interconnections and creating new high-density devices, thus making it possible to integrate different technologies and functional forms on the same support, and this enables us to look forward to new uses.

"Integration in terms of three dimensions consists of stacking up layers of different functional forms, for example, a software layer, a high-voltage layer, and optoelectronic couplers," explained Alain Roche, of Thomson Semiconducteurs (Grenoble).

This company is involved in two ESPRIT [European Strategy Programs for Research and Development in Information Technology] contracts (numbers 14 and 245), involving integrated 3D circuits and presented at the third ESPRIT Conference held in Brussels from 29 September to 3 October 1986. Contract 14, christened "Multilayer Interconnection of VLSI," uses this third dimension to put together interconnections between different levels. Grouping the Plessey, GEC (General Electric Company), and Telefunken companies around Thomson, this project is aimed at developing a system of interconnections with four compatible levels using the MOS [metal oxide semiconductor] and bipolar micron and submicron technologies.

Contract 245 deals with the superimposition of active layers specifically, MOS devices made up of SOI [silicon on insulator] on a layer of MOS circuits integrated into the silicon substrate. Thomson's French partners for this project include the CNET [National Telecommunications Studies Center], Grenoble), the LETI (Electronics and Data Processing Technology Laboratory), the CEA (French Atomic Energy Commission), GEC-HRC [General Electric Company--Hirst Research Center], as well as the British unive[illegible]es of Cambridge and Cork. Thus, adds A. Roche, "when 3D integration is [illegible]ble for production,

it will permit regrouping several functional forms and different technologies on the same substrate."

A European Project

These two projects are a part of the ESPRIT subprogram entitled "High-tech Microelectronics" which is aimed at increasing the complexity of circuits and reducing their dimensions (Figure 3).

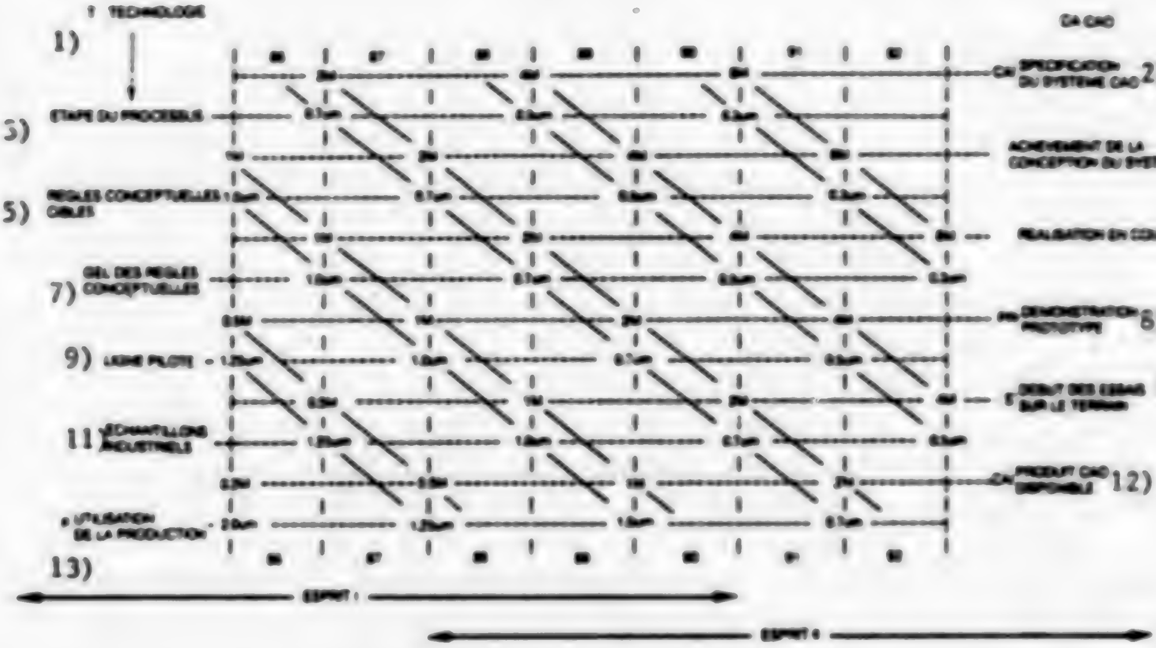


Figure 3. Parallel Development of CMOS Technology and CAD (computer-assisted design) in the Context of the ESPRIT Program.

Key:
1. Technology
2. CAD System Specification
3. Process stage
4. Completion of system design
5. Design rules, targets
6. Implementation of progress
7. Finalization of design rules
8. Prototype demonstration
9. Pilot line
10. Start of field tests
11. Industrial samples
12. CAD product available
13. Use of output

The feasibility studies involve a DMOS (double-diffusion MOS) device on solid silicon for the lower layer and CMDOS/SOI (Complementary MOS/silicon on insulator) for the upper layer. The prototype will bring out the problems which may be raised by SOI technology as well as the interconnections between the two levels. The purpose is to check the technological choices for a demonstration circuit in 1989.

On the silicon section, which is half a millimeter thick, the circuit itself uses only a few microns of thickness, while the "active" layer and the rest of the semiconductor serve to support the software functions under good conditions. We can thus envisage using this support to make several circuit elements separated from each other by an insulating layer. Independently of its importance to 3D integration, the SOI technology makes it possible to save on a material which is relatively expensive to get.

Starting with a conventional integrated circuit, such as the one shown in Figure 2 [not required], we cover it with a sufficiently thick insulating layer, then with a new semiconducting layer having a thickness of several microns on which other circuit elements are "processed." This operation can theoretically be repeated n times for each functional type.

The interconnections are made after the component parts have been defined. Several solutions are possible: either the wells are prepared in the insulating layer and are filled with metal when the upper circuit is made; or, under certain conditions, the holes are punched at the end of the process (Figure 4).

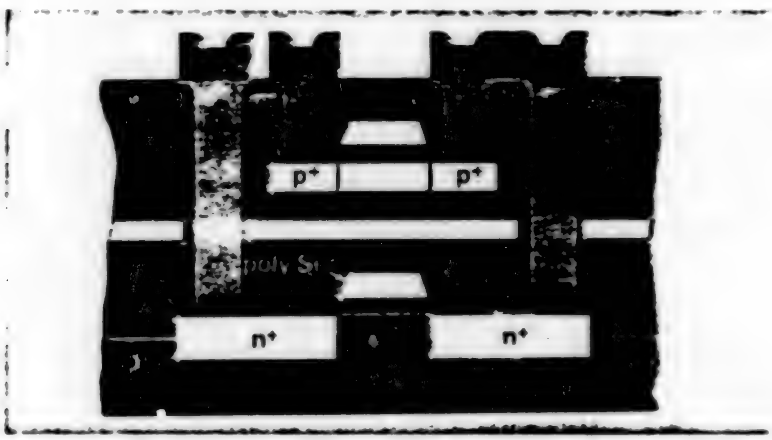


Figure 4. Multilayer SOI/CMOS structure in which the silicon layers on the insulator are stacked up on top of each other, with the zero order layer being the substrate. The different layers are interconnected by means of a conventional metal treatment process. According to J.-P. Colinge, CNET.

Making the "Bricks"

Jean-Pierre Colinge, of the CNET in Grenoble, calls our attention to two key points of integration in three dimensions: on the one hand, to increase the semiconductor films on an insulating support; on the other hand, to make circuits on the upper layers without interfering with the good operation of the lower structures that have already been made.

Before being able really to make integrated circuits in three dimensions, we must master the materials involved in these circuits--semiconductors, insulating, metals--and above all their interfaces: semiconductor on insulator, semiconductor on metal, and the other way around. The studies conducted in these fields, in particular by the CNET and the LETI, constitute the "bricks" for the foundation which will make it possible to build three-dimensional circuits. Right now, explains Maurice Quillec, of the CNET in Bagneux, "We are in the process of making those bricks. Then it will be possible to make in 3D everything we know how to make in 2D technology."

The LETI acquired knowledge and technological knowhow in the matter of interfacing electronic and optical circuits. The Laboratory combined components of two different technologies on one and the same silicon substrate: an optical circuit linked to detection elements and a micro-electronic circuit for signal processing. The optical circuit comprises microguides consisting of silicon nitride (Si_3N_4) or doped silica (SiO_2). The electronic circuit is a series of operational amplifiers based on CMOS technology.

Silicon on Insulator

The question that keeps many researchers busy at this time, especially those at the CNET and the LETI, has to do with the growth of the semiconductor on insulators to make a new layer on which other circuits will be implanted. The Norbert Segard Center (CNET, Grenoble) is involved in a program having to do with the integration of silicon transistors deposited on insulating materials. This is the SOI ("Silicium On Insulator") technology which opens the way to the construction of silicium [silicon] circuits in three dimensions.

This technique consists of making a thin layer of monocrystalline silicon on an insulating substrate. Two methods are possible: annealing on the basis of amorphous or polycrystalline silicon or epitaxy. The CNET team, which picked the first method, developed an original microfusion technique. First of all, a layer of polycrystalline silicon is deposited on insulating silica (SiO_2); a laser beam then locally fuses the deposit which is recrystallized in the form of monocrystals. To process the entire plate, we must sweep the entire surface with the laser. Problems can arise at the points of overlap between successive sweeps.

Recrystallization can also be achieved on the basis of silicon which was fused by preheating the substrate to 1,100 degrees Celsius. To do that, the CNET developed a machine which permits the recrystallization of small plates with a diameter of 10 cm. To prevent the formation of drops or defects of the grain joint type, the Norbert Segard Center developed an effective method: it consists of etching into the insulating substrate a network of bands with a width of 4 micrometers, spaced 40 micrometers apart. On the substrate thus engraved, we then deposit a layer of about half a micron of polycrystalline silicon which is then covered with 1.5 m of silicon. The defects then are gathered along the length of the network bands and it thus suffices to position the circuits in the intervals between these bands.

The LETI achieved good results for the monocrystalline layer of silicon on insulator: the density of dislocations was on the order of $10^7/cm^2$. The quality of the material enables us to contemplate the manufacture of several categories of micronic or submicronic CMOS circuits, in other words, in one and the same tiny spot to combine widely different components (transistors, detectors, operational amplifiers, etc.).

Integration of Graphic Functions

Jean-Francois Rochette, product manager of the Picogiga Company, specializing in gallium arsenide technique, suggests making the microwave [ultrahigh-frequency] part of the receiving head of a satellite of gallium arsenide on silicon. This company furthermore developed an epitaxy process by means of molecular jet or MBE (Molecular Beam Epitaxy) to enable the gallium arsenide layer to grow on a substrate.

Insulator and Conductor on Semiconductor

To make 3D circuits, we must enable a layer of insulator to grow on the semiconductor layer so as to separate both active layers. In silicon technology, this stage does not create any problems: it is current practice to deposit a layer of silica (SiO_2) on silicon. Researchers are trying to establish a parallel between what is done for silicon and what could be done for gallium arsenide circuits. Until recent years, we did not yet know how to do a good job in making an insulating layer grow on gallium arsenide as this is currently done in the case of silicon during the production of MOS transistors. The team of Mr Munoz-Yage at LAAS (Automation and Systems Analysis Laboratory), Toulouse, recently managed to grow by epitaxy process calcium fluoride insulator on gallium arsenide.

Finally we must also make the conducting parts of these circuits, in other words, we must grow metal on semiconductors. Experiments are being conducted at Grenoble with cobalt silicide on silicon. At Lannion, a similar approach is being pursued with the epitaxy of rhodium arsenide conductor on gallium arsenide.

"The techniques show that it is no trivial thing to make several levels," admitted Mr Ben Sahel, of the Grenoble CNET. "Right now, the studies are concentrated primarily on materials. But," adds Mr Ben Sahel, "the material problem is much less important than the technological problem, pertaining to the circuit manufacturing processes, which would account for 80 percent of the work on 3D circuits. Once the material problems have been solved, the technology increases the costs and reduces the output. Besides, it is not certain that three-dimensional integration makes it possible to gain in terms of density because it is necessary to provide the place for punching the holes that will be used for the interconnections."

3D Checkout Circuit

The ESPRIT Project is aimed at building a 3D checkout circuit of the "SOI Mezzanine Gate Array" type. It consists of placing, in solid silicon, the output power circuits which will be made in the LDMOS technology and an upper

layer of CMOS/SOI, constituting the prediffused hardware control circuit ("Gate Array") (Figure 6) [not required]. The SOI zone is shifted in "mezzanine" fashion, with respect to the power zone. A prototype of such a circuit, scheduled for 1987, should demonstrate the feasibility of 3D integration and will make it possible to contemplate a potential followup between 1987 and 1988.

The mezzanine-style arrangement makes it possible rather easily to solve the problem of heat dissipation. As a matter of fact, when many circuits are squeezed into a small volume, it generates heat. It is generally agreed that heat dissipation must not exceed 1 W per box. "In a 3D circuit, we will try to put the power circuits (which generate most heat energy) in the mass of the chip, in other words, the lower layer, linked to the box; the latter can contain the radiators to evacuate surplus heat," explains A. Roche. The software and memory circuits, which dissipate less than the control portion, can without any inconvenience be placed in the intermediate layers.

Increasing Circuit Operating Speed

These studies promote progress in the development of microelectronics. We thus expect that the SOI structures will increase not only the degree of integration of components but also the operating speed of the circuits; indeed, the surfaces of the junctions and associated capacities are minimized with respect to circuits on solid silicon. The LCR (Central Research Laboratory) of Thomson, in collaboration LETI, is studying new SOI structures--called SOZ ("Silicon On Zirconia")--which, as insulating substrate, use a stabilized zircon crystal and a thin layer of silica.

In addition to the progress which these studies produce in the development of microelectronics, the 3D technology should make parallel computation and its applications, especially signal processing, accessible to microprocessors. The 3D circuits could constitute real complete electronic systems.

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CSO: 3698/614
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FRANCE ANNOUNCES 1988 R&D BUDGET

36980008 Paris LES NOTES BLEUS in French 28 Sep-4 Oct 87 pp 63-65

[Text] The proposed increase in expenditures for research and development (+10.5 percent versus 1987) reflects the priority being accorded to this sector by the Government in its 1988 spending bill.

The allocations being made to R&D, mainly in the budgets being submitted by Research and Higher Education, Defense, Industry, Posts and Telecommunications, and Civil Aviation, will thus come to 85.7 milliard [billion] francs.

The size of this allocation is owing to the need to improve the French research situation.

The fact is that although the French public sector outlay in this domain (1.45 percent of the GDP [gross domestic product]) exceeds that of the FRG (1.15 percent) and of the United States (1.22 percent), France's total national expenditure on R&D, on the other hand, represents only 2.3 percent of its GDP, versus 2.7 percent in the FRG and 2.8 percent in the United States and Japan. This situation is owing essentially to the insufficiency of the part of research being financed by French enterprises, and to that of public sector's outlay that is oriented towards industrial research and towards improving the competitiveness of enterprises.

In addressing this dual concern, the 1988 budget bill provides for five major lines of government intervention to promote research.

Significant Increase in Public Sector Outlay on R&D

The total budgetary outlay is to be increased by 10.5 percent, and the exclusively civil-sector outlay by 7.7 percent.

The proposed allocation of credits is shown in the accompanying table.

Public Spending Priority Accorded to Industrial Research

This proposed redistribution of the public outlay will result in increased subsidization to enterprises homing on industrial research.

ANVAR's [National Association for the Implementation of Research] budgetary allocations(1) in support of innovation are being increased from 425 to 640 million francs, up 50.6 percent.

In addition, those of the FRT [Research and Technology Fund](1) are increased from 655 million francs to 953 million francs (+45.5 percent), and are shifted towards industrial research, hence assigned, for the most part, to enterprises.

A sizable increase (+27 percent) in France's share of the cost of the EEC research program is also provided for. A major part of these expenditures is for industrial research implementation programs that will result in a substantial number of fallouts for French enterprises (Esprit and RACE programs).

French participation in Eureka programs is expected to come to around 850 million francs in public-sector subsidies in 1988, making France the leading country in the providing of public funding for these projects.

Research Tax Credit Increase

Owing to its multiplying effect, the research tax credit increase to 500 million francs (+45.5 percent) should result in a greater contribution by the enterprises to the financing of research.

More so than direct subsidies, the research tax credit is available to all enterprises in all sectors of activity. It thus contributes to a strengthening of the industrial sector, by helping a large number of enterprises to increase their outlay for R&D to the level necessary for their growth and for enhancing their competitiveness.

Support of a Sizable Volume of Basic Research

The funding of basic research is being increased.

Thus, in a budgetary context calling for a reduction in public spending, the "research" section of the Research and Higher Education Ministry's budget, which represents around half the civil R&D budgetary outlay, shows an increase of 2.0 percent in DO [Operating Expenses] plus CP [payment appropriations].

Job cutbacks in public sector scientific and technological establishments(2) are being limited to 65, equivalent to 0.2 percent of regular staff. A total of 150 jobs for researchers are being created at CNRS [National Scientific Research Center], INSERM [National Institute for Health and Medical Research], INRA [National Agronomic Research Institute], and ORSTOM [Overseas Scientific and Technical Research Office]. Not counting their personnel budgets, these establishments are slated for a 2.4-percent increase in appropriations.

Budget Outlay for Research and Development

Item	1987 LFI (Millions of Francs)	1988 LFI (Millions of Francs)	Increase 1988/1987 (Percent)
Min. of Research & Higher Education:			
Research Section	20,917	21,335	+ 2.0%
(including FRT)	(655)	(953)	(+45.5%)
Higher Education Section:			
Operating expenses	7,095	7,399	+ 4.3%
Capital expenditures	1,569	1,826	+16.4%
ANVAR:			
Operating expenses	156	158	+ 1.3%
Capital expenditures	425	640	+50.6%
EEC (French share of research budget)	1,060	1,353	+27.6%
Civil aeronautics programs	3,308	4,405	+33.2%
Electronics sector(1)	2,181	2,308	+ 5.8%
Nat'l Space Studies Center [CNES](2)	4,377	4,762	+ 8.8%
Telecommunications research	4,173	4,581	+ 9.8%
AEC [Atomic Energy Commission], industry budget(3)	3.852	3,892	+ 1.0%
Miscellaneous	2,296	2,276	- 0.9%
Research Tax Credit	1,100	1,600	+45.5%
Total civil outlay	52,509	56,535	+ 7.7%
Defense Ministry R&D	25,000	29,148	+16.6%
Total R&D outlay	77,509	85,683	+10.5%

1) Including INRIA but excluding ADI [Data Processing Agency], dissolved in 1986, and excluding CESIA [Center for Study of Administrative Information Systems], which is currently being privatized. The 1987 credits concerning these two agencies are included in "Miscellaneous."

2) CNES operating expenses (646 million francs in 1987, and 663 million francs in 1988) are included in the Research Ministry's budget.

3) Including EDF [French Electric [Power] Company] contribution.

Top priorities are being assigned to research in data processing and medical research (an increase of 8 percent in appropriations for other than personnel for INRIA [National Institute for Information Technology and Automation Research], and of 3.1 percent for INSERM).

Since basic research is being done in research establishments, but also in institutions of higher learning, the public-sector outlay for university research also translates into a 16-percent increase in appropriations (for other than personnel) and the creation of 417 teaching-and-research jobs in the universities.

Reaffirming the Strategic Importance of Major Technological Development Programs

These major programs, designed to introduce leading-edge technologies into key sectors of the national economy, are targeted for continued development.

Appropriations for civil aeronautics programs are to be increased by 33 percent, owing particularly to the launching of the Airbus A-330 and A-340 programs, which will update and extend Airbus Industrie's product line.

Budgetary allocations to CNES [National Space Studies Center] are being upped from 5,023 million francs in the 1987 LFI [Initial Finance Law] to 5,425 million francs in the 1988 PLF [Finance Bill]. This 8-percent increase reflects the importance being accorded by the Government to space R&D. A high priority is assigned to launch facilities, budgetary allocations for which are being upped by 444 million francs (+29 percent), providing for a very sizable outlay to improve the reliability of launchers and for the expected increase in expenditures under the Ariane 5 launcher development program. In addition, 40 jobs are to be created at CNES in connection with the growth of this body's activities.

The developmental program of a new generation of telecommunications satellites, Telecom 2, will entail a 10-percent increase in R&D appropriations to the General Directorate of Telecommunications, independently of those provided under the CNES budget.

The priority being given by the Government to research also translates into a sizable increase in military spending credits. These credits will total 29.1 milliard francs (+16.6 percent). They will cover continued military space development, with the Helios earth observation satellite program, which will benefit from the experience provided by the Spot 1 and Spot 2 earth observation probatory satellites, and with the Syracuse 2 program, the military portion of the Telecom 2 telecommunications program, which will enable an improvement in military telecommunications.

FOOTNOTES

1. Program authorizations allocated to ANVAR and FRT will increase their appropriations by 10 percent and 24 percent respectively.

2. CNRS, INRA, INSERM, ORSTOM, CEMAGREFF, INED, INRIA, INRETS.

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CNRS OFFICIAL DESCRIBES FRENCH S&T SYSTEM, CONTRASTS WITH FRG

Paris THE ORGANIZATION OF SCIENCE AND TECHNOLOGY IN FRANCE AND A COMPARISON WITH THE FEDERAL REPUBLIC OF GERMANY in English 27 May 87 pp 1-16

[Paper presented by Dr Jean Pierre Chevillot, research director of the French National Center for Scientific Research (CNRS), at international conference on "The Organization of Science and Technology in Western Industrialized Countries--An International Comparison" in Bonn, 26-27 May]

[Text] Introduction

It is usual to appreciate the situation of research and development (R+D) in a country by measuring the part of its gross domestic product (GDP) devoted to it.

Regarding this global indicator, France has accomplished an important effort during the recent period by increasing this ratio from 1.8 percent in 1980 up to 2.3 percent in 1985 (2.7 percent in FRG). However only 3.3 percent of the active population are employed in R + D as scientists or engineers (7.7 percent in FRG).

But R + D activities are occuring in a complex system, the yield of which depends on the way these resources are used. The structure of this economic operator is therefore still more important than the amounts of resources put in the R + D - system.

Secondly, many of the most promising scientific results are now produced at the boundaries between different disciplinary fields. In a similar way, the most important parts of the R + D - system consist in the interfaces between the different sectors concerned with the R + D - processes.

So that, following a first section devoted to a structural analysis of the French R + D - system, attention will be focused here on the interfaces of research with respectively industry and education.

1. Structure of the R + D in France

1.1 Organization at the Ministerial Level

The splitting of the French higher educational system between universities and

engineering higher schools seems to be one major reason for the disconnections between the three poles of technical development which are education, research and industry.

On one side, scientists are educated in universities in order to make career in research institutions, on the other side engineers are trained in the schools in order to make career in companies or in high administrations. They have few common backrounds and they do not easily work together.

The different changes of the R + D organization in France during the last 6 years have, indeed, been motivated by this situation. The accent has been put successively:
--in 1981 and 1984 on the policy of R + D as a global and coherent unit with a strong full-rank Ministry of Research and Technology (MRT)
--in 1982 on the link between research and industry with a Ministry of Industry and Research (MIR)
--in 1986 on the link between research and higher education with a unique Ministry of Research and Higher Education (MRES).

As compared to FRG, a significant distinctive feature of France is the existence of a Ministry of Industry in addition to a Ministry of Economy and a Ministry of Research.

This point led to a severe difficulty in 1981 concerning the ministerial responsibility of technology. The same difficulty reappeared in 1986.

The responsibility of technological development is revendicated [as published] by the Ministry of Industry because it's a crucial factor of industrial development. The same responsibility is revendicated too by the ministry in charge of research because it's very damageable to let the gap between research and its applied developments become wider.

Following this last argument, CNRS has been, in 1981, for the first time, picked up from the ministry of education and universities, to be transferred to the newly created ministry of research and technology. This transfer, in spite of a strong opposition from universities, made CNRS closer to technology and to industrial companies, made possible an opening of basic research to industrial applications, as well as a deep change of the respective mentalities of research and industry people for each other. This opening of CNRS in direction of its surroundings, induced progressively the same change of attitude in universities.

However an important difference to this respect between France and FRG, consists in the existence of a ministry of universities at national level. Fears entertained by the universities of losing support for fundamental research by such an apart situation of C.N.R.S. led in 1986 to a new ministry managing together research and higher education.

But the configuration put in place in 1986 is probably not a definite one. Especially taking into account the orientation of the French economics policy since several years I think that the ministry of industry will more and more be concerned with horizontal structural policies and less and less with sectorial vertical ones.

In the new structure of the ministry of industry structural horizontal departments have taken the place of former industrial branches directions.

One consequence of this evolution is that the industry ministry wants to be more and more involved in the most important transverse question, that of industrial technological development. Therefore the partition of responsibilities between the two concerned ministries is crucial again. They are clearly defined at both ends of the R + D system schematically divided in research-development-innovation. Research belongs to the MRES, innovation resorts to the ministry of industry. The partition is not clear concerning technological development. There is some difference between the administrative texts which are in favour of the ministry of research and the praxis which seems actually in the hand of the ministry of industry. It is now the case of ANVAR for example. So that some adjustment could happen in the near future.

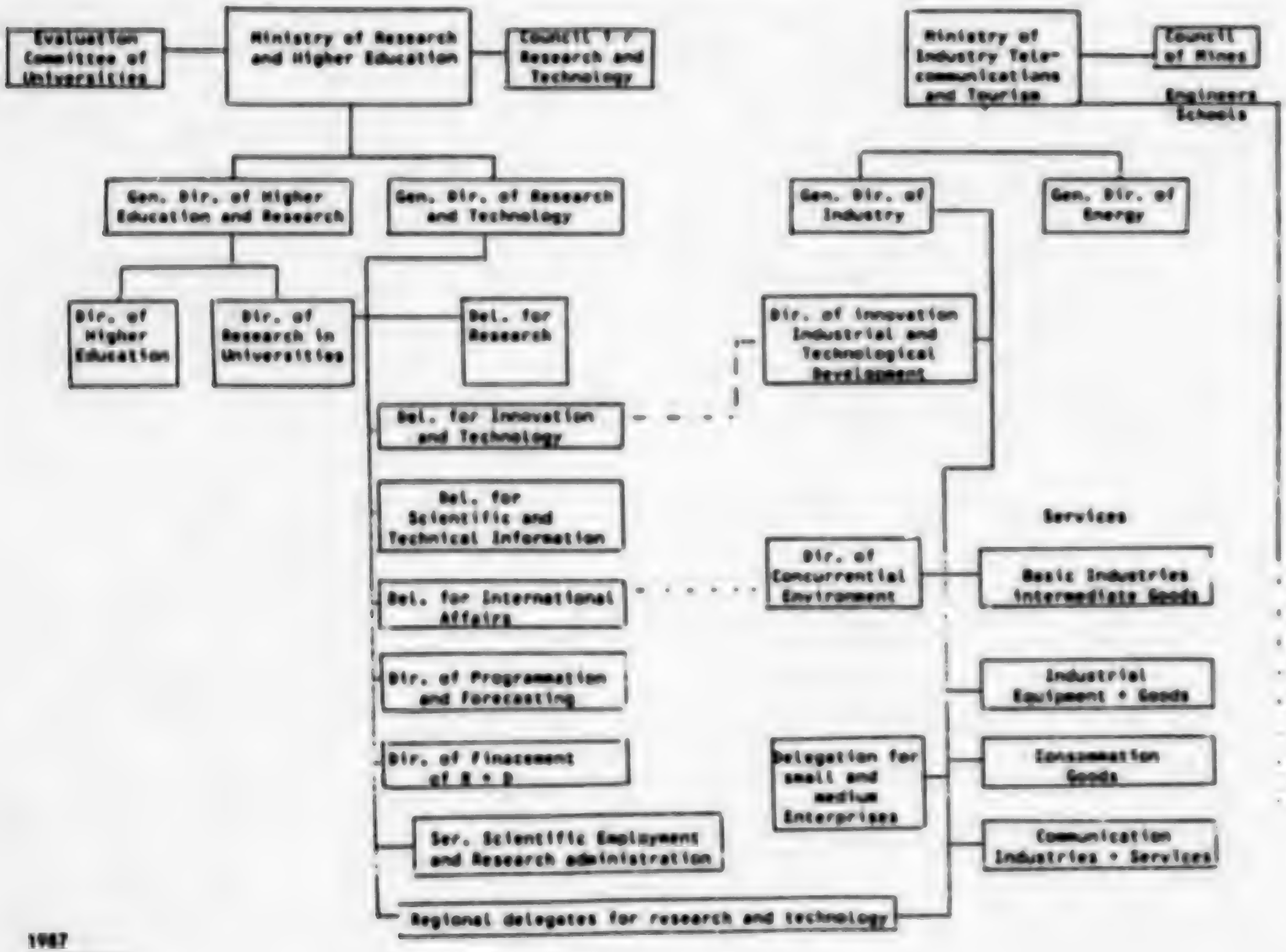
The diagram shows the organization of the two ministries concerned with R + D. (see table I)

The former MRT was made by two bodies, the "scientifical and technical mission" with corresponding expertise responsibilities, the general direction of research and technology with administrative and financial responsibilities. This dual parallel structure inherited in 1982 from the previous institutions was rather conflictual. It has been left.

The new research structure, closer to that of B.M.F.T., is made by seven operational directions, delegations and services, each of them devoted to a particular task with people of both qualifica-depending [as published] on the nature of this task, the whole constituting under the name of general direction of research and technology, the part devoted to R + D in the ministry of research and higher education.

Ministerial offices involved in R + D

table I



1987
unofficial

To be noticed is the trend to make this ministry independent from the ministry of industry which had held with the former ministry of research and technology several common services, especially concerning foreign and regional affairs. The link is maintained in the regions where the regional delegates for research and technology belong further to the regional directions of industry.

But the independence gained on the industrial side has been lost on the educational side, the minister of research and higher education being not a full rank minister, but delegated by the minister of education.

1.2 R + D Budget Structure

Opposite to the versatility of the structure of the ministry in charge of research, the interministerial character of the R + D civil budget in France is an invariant since 1959.

Since 1981, the ministry in charge of research has its own budget including the public research institutions for which the ministry is responsible. This represents the first circle, or say, the inner core of the French R + D budget: 21 billions francs in 1987, of which 10 billions for basic research. (see table II)

The ministry is in charge of the so-called "civil R + D budget" (BCRD), 39 billion francs in 1987, including in addition to the inner core, the programs of technological developments (PDT): nuclear energy 3.8, aeronautics 2.2, and space 4.4 billion francs, as well as the other activities of sectorial ministries involved in R + D. This BCRD is represented by the second circle and described every year in the "yellow report" presented by the government to the parliament with its annual budget proposals.

Beyond this second circle lie three sectors traditionally outside the BCRD: defense R + D activities 30 billion francs in 1987, telecommunications R + D 4 billion francs and the universities personnel research salaries, depending on the education budget 7 billion francs, plus the regions' own R + D expenditures (0.5 billion francs in 1986).

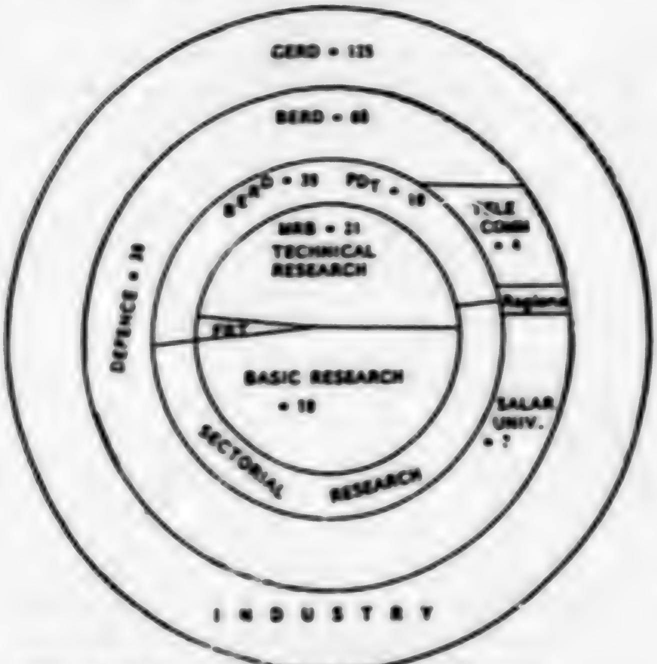
Altogether the third circle represents the whole budget expenditure on R + D, 80 billion francs in 1987.

The last circle represents the total national R + D expenditure which is expected to amount in 1987 to 125 billion francs (taxes not included).

FRENCH R and D TABLE II

EXPENDITURE STRUCTURE

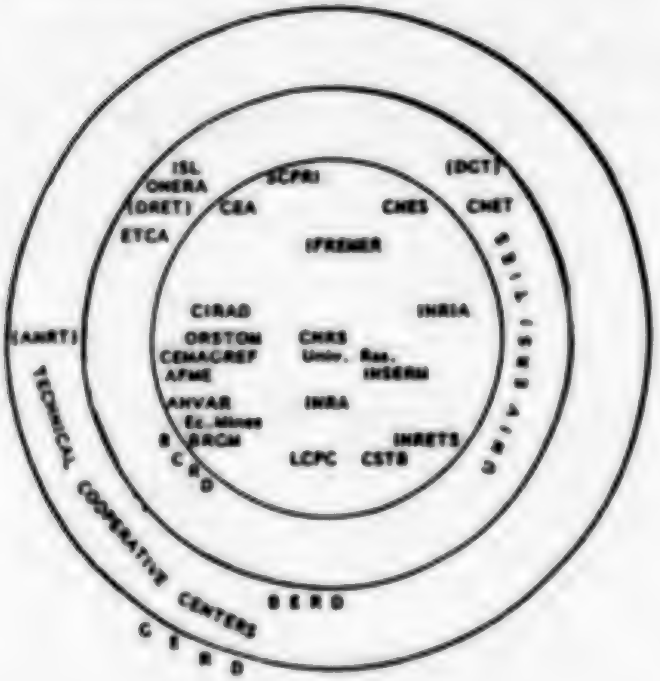
Expected figures 1987 in Billions FF



GERD = Gross expenditure on R & D (taxes not included)
BERD = Budget expenditure on R & D (taxes included)
BCRD = Civil budget on R & D (" id. ")
MRB = Ministry of research budget (" id. ")
PDT = Technological development programs (" id. ")

FRENCH R and D TABLE III

INSTITUTIONAL STRUCTURE



A particular illustration of the interministerial character of this organization is given by the Interministerial Committee for Scientific and Technical Research, which is chaired on behalf of the Prime Minister by the Minister in charge of research and to which belong all ministers concerned by R + D, especially the Minister of Finance.

The next figure, combined with the former one, provides a visualization of the corresponding distribution of the different public R + D institutions, of which the next table indicates the annual budget and personnel employment. (see table III)

1.3 R + D Program Structure

	billions FF	Percent
Total public budget expenditure on R + D for 1985 (all taxes included)	73.4	100
BDRD	39.6	54
Oriented programs (Diffusing technologies)	15.5	21.1
Basic research	9.0	12.3
Technological development programs (PDT)	8.3	11.3
Indirect means	6.4	8.7
Tax credit for industrial R + D	0.4	0.6
Outside BDRD	33.7	46
Defense R + D	22.8	31.1
Universities' personnel R + D activities	6.7	9.1
Telecommunications R + D	3.5	4.8
Regions	0.7	0.9

real figures
Sources: MRT, OCDE

While the budget structure is administratively significant, the program structure must be scientifically and technologically significant.

Programation as a major tool of the R + D policy has got a great importance since 1982, with the vote by the Parliament of the first program bill devoted to R + D. The second one has been voted in 1985.

Programs are of two main types:
--to achieve large technological goals in nuclear energy, space aeronautics; these are the technological development programs (PDT)
--to promote basic technologies diffusing through many industrial branches and governing their pompetitivity in electronics, bio- technologies, new materials..., among these orientated programs are the so-called "programmes mobilisateurs [mobilization programs]."

Research Public Institutions
(expected figures 1987)

Table III

Institutions	Related fields	Personnel: Scientists & Engineers	Personnel: Total	Annual budget (billions FF)
CNRS	basic research	12 500	25 700	8.8
DR/EN	" " univ.	30	1 100	1.6
Universities		45 000	-	7.0
INSERM	biomedical	2 000	4 400	1.6
INRA	agronomy	2 000	8 200	2.2
CEMAGREF	" mechanism	110	600	0.14
ORSTOM	develop. countries	790	1 500	0.70
CIRAD	tropical agro.	560	1 100	0.50
CEA	atom	4 200	14 500	7.0
	(research only	1 700	5 800)	
CNES	space	950	2 000	5.0
INRIA	informatics	300	550	0.26
IFREMER	oceanography	320	1 100	0.78
Ec.Mines	basic technol.	200	450	0.14
BRGM	mineral resources	200	400	0.20
INRETS	transport	180	380	0.15
CSTB	construction	125	320	0.12
LCPC	equipment	120	380	0.13
ANVAR	indust.dev.agency	20	350	0.75
AFME	energy saving + use	-	140	0.25
SCPRI	radiation protect.	-	130	0.04
	meterology	130	250	0.16
CNET	telecommunications	1 500	4 300	1.7
ONERA	aeronautics	-	2 100	1.25
ECTA	defence	-	-	-
ISL	" fr.germ.inst.	-	-	-

Programs are pluriannual and their programation matrix overlap the boundaries between ministries, research institutions, disciplines, public administrations and companies sectors.

Balance between budget structure and program structure in the R + D policy making process is very important. It depends on the weight balance between the ministry of finance and the ministry in charge of research. This balance fluctuates as a function of time, depending on the attention paid by the government to the R + D policy as such.

The elaboration of the R + D budget involves two approaches which must be combined: one in terms of scientific and technical orientations and priorities, the other in terms of institutional budget lines and their relative variations.

When the weight of the ministry of research is high, as for example during the period 1982 - 1985, the first approach is prevailing. Then the public research institutions, especially the big ones as CNRS, INSERM, INRA, CEA, CNES... have to negotiate their budget proposals with the ministry of research in the frame of the national R + D policy, and the ministry of research is the only partner of the ministry of finance during the final phase of global decisions. After that the distribution of the great masses between particular programs, institutions, is of the major responsibility of the ministry of research.

In the other case, the second approach is prevailing. Then the public research institutions, the different sectorial ministries are going separately to negotiate directly with the ministry of finance, each alone for its own budget. The result is not in favor of research, neither in amount of means nor in orientation of choices.

1.4 Budget Expenditure Structure

It is also interesting to analyze the budget by nature of expenditures. The civil budget for R + D (BCRD) in 1985 was composed the following way:

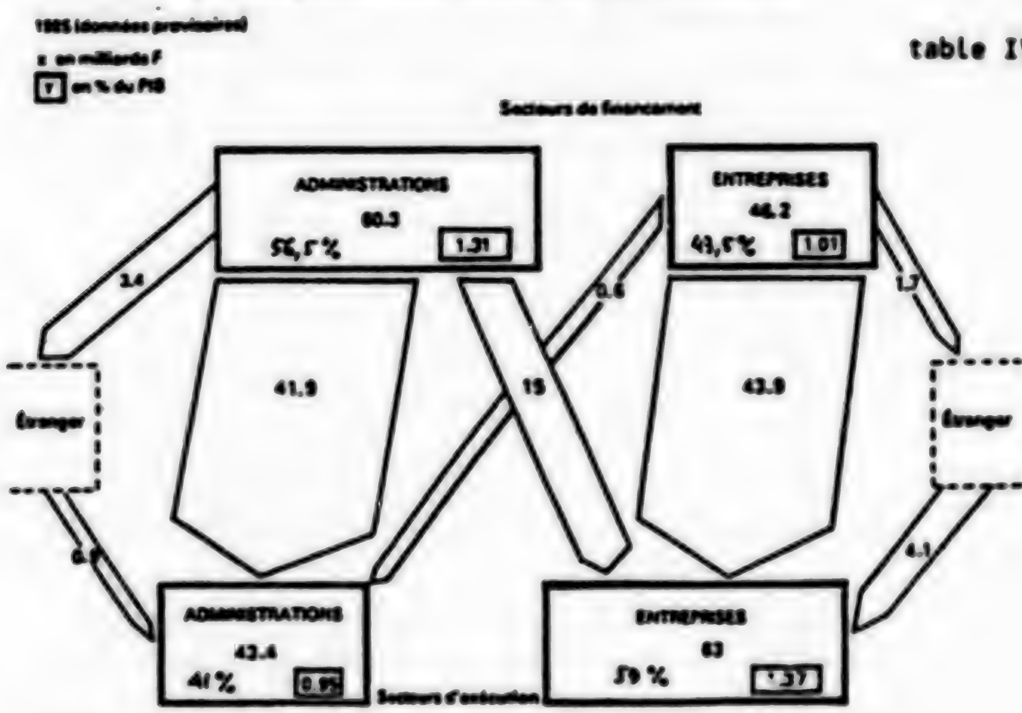
		(millions francs)
--"ordinary expenditures" (DO) salaries and other fixed charges		18 500
--"capital expenditures" (AP)		
.institutional fundings (recurrent)	(6 000)	
.incentive funding (non recurrent)	(6 000)	
.technological development (civil only)	(4 500)	
.international cooperation and big R + D facilities	(4 000)	20 500
		------
		39 000

1.5 Financing and Execution Structure

Estimated figures for 1985 are given by the flow diagram below: (see table IV)

Structures de financement et d'exécution de la recherche en France

table IV



Source : MRES

It shows the well-known weakness of industrial research in France compared to public research, not only in terms of own capacities of financement by the companies, but in terms of the part they are taking in execution too. The situation in this respect is quite different in most other advanced countries:

Percent GERD 1984	Performed by enterprises	Financed by enterprises
USA	71	49
FRG	70	57
UK	61	43
Japan	64	65
Italy	53	41

Source: MRES 1986

Evolution of this structure during the last decade in France has been as it follows:

Percent GERD	1975	1979	1981	1981*	1983	1985
Part financed by enterprises	40	44	43	42	43	43.5
Part performed by enterprises	60	60	61	59	57	59

*) mode of calculations readjusted since 1981 in order to take better account of:
--activities of research in universities (part of salaries raised to 50 percent
--activities of R + D in particular fields of defense sector
--consequences of taxation on added value introduced for public research institutions.
Source: MRES 1986

Since the seventies, financement by enterprises has increased by a mean real annual rate higher than 6 percent (real volume increase) and this effort has continued on the same rhythm after 1980. Because the public effort in R + D has decreased between 1970 and 1980, and then strongly increased, the part of industrial financement raised from 37 percent in 1971 up to 43 percent in 1981 (at constant statistical reference) and then remained quite stable at about the same value of 43 percent.

Concerning execution, the variation was in the opposite direction. The relative part of R + D performed by enterprises raised by 15 points between 1960 and 1975 up to 60 percent and then remained stable. But this ratio

decreased again after 1980 down to 57 percent in the years 1983 and 1984. I shall come back to this point in the next section.

The comparison with FRG leads here to a striking difference which has been even accentuated in 1985 as consequence of an increase of R + D effort by German enterprises, the part of which in financing R + D is now just below 60 percent GERD, the part in execution up to 72 percent.

The next diagram shows comparatively the evolution of this structure in five countries from 1979 to 1984, tabulated in parts of GDP. (see table V)

table V

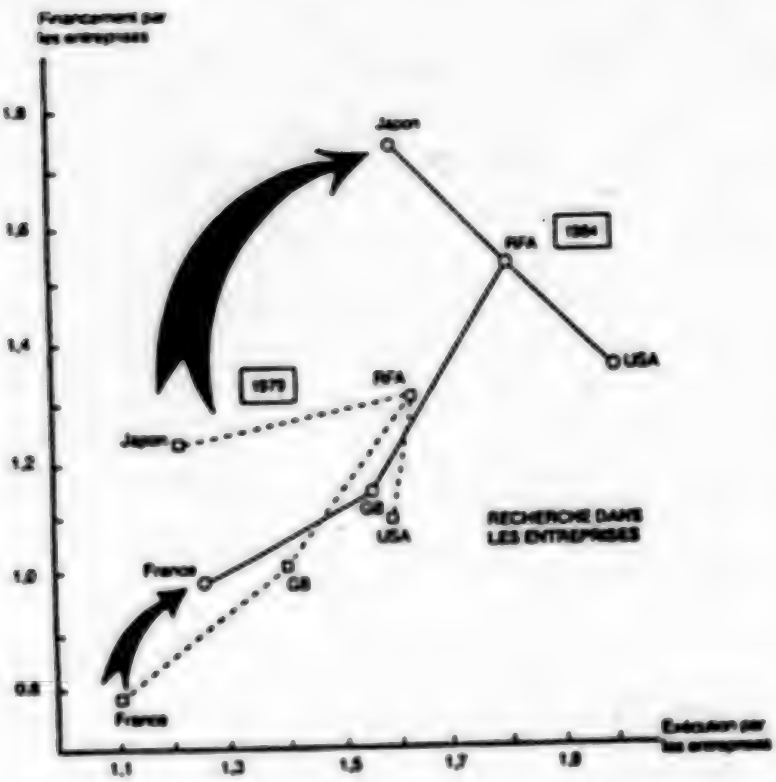
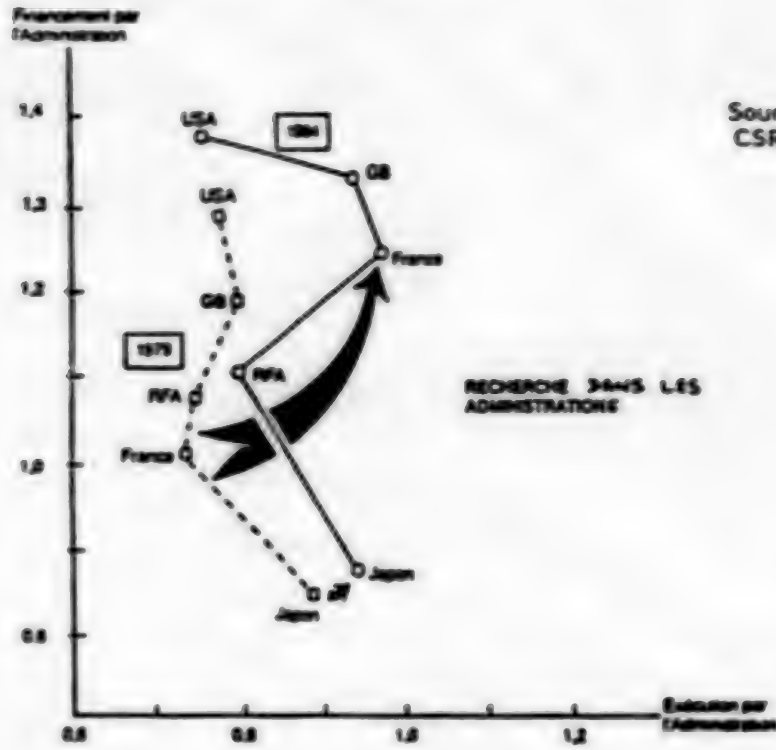


Figure 1: Company research and percentage of GNP in the 5-year period 1979 - 1984 (OCDE)

Fig.2: " id" dans les administrations



Source:
CSRT, oct.1986

2. Interface Between Public Research and Industry

2.1 Executio: Transfer to Inudstrial Sector

The precedent data show that an important increase of public effort on R + D has not been followed by the same movement in industry, the effort of which has been improved too, but not in a way to re-establish a better ratio between public and industrial financement.

The most part of increase of industrial expenditures on R + D came from big national enterprises and high technology groups, but other companies did not achieve the same effort on R + D.

The financing structure of industrial R + D is a slowly variable parameter, controlled by basic socio-economical conditions.

It is the reason why, in the French case, it seems very important to act upon the execution structure which can be changed more rapidly by an adequate governmental policy, acting by the mean of what I call "execution transfer to enterprises" from the public sector.

This "execution transfer" is represented in the precedent flow diagram by the arrow crossing down from the block financed by administrations to that performed by the enterprises.

This transfer has been evaluated to 15 billion francs in 1985 and the analysis of its variation from 1981 shows an anomalous feature:

in million francs	1981	1982	1983	1984	1985
public R + D budget	36 100	43 170	48 970	55 470	60 300
execution transfer to enterprises	9 060	10 490	10 790	12 360	15 000
percent	25.1	24.3	22.0	22.3	24.9

Source: calculated from rapport annexe 1986

The transfer did not increase during this period at the opposite of what could be expected. The decrease even registered in 1982 - 1984 is related to decreasing public orders of R + D to enterprises, especially in the fields concerned with defense activities.

However, it is a general trend of this period, that the increase of public expenditure led primarily to an increase of activities in the public R + D institutions and not so much in industrial companies, as the advisory body for research and technology has stated it in its report on industrial research in 1985.

Comparatively, this execution transfer to enterprises is much higher in the FRG, in spite of a much stronger too own R + D effort paid by the enterprises:

in million DM	1981	1983	1985
public R + D budget (Bund + Lander)	17 000	18 200	20 700
execution transfer to enterprises	4 840	5 250	6 410
percent	28.5	28.8	31.0

Source: calculated from Faktenbericht 1986

The "reverse transfer" from financement by enterprises to execution in public research institutions, is an important indicator too, reflecting the degree of partnership between the industrial research and the basic research done in universities and public centers.

This reverse transfer amounted 1.3 percent of financement by enterprises in 1985 in France, 1.2 percent in 1984, the corresponding values in FRG being 2.7 percent in 1985 as in 1983.

2.2 Industrial Spin-off by High Technological Developments

The major part of transfer consists in France in R + D activities ordered by public authorities to enterprises in the fields of defense, space and aeronautics. Success that France got in the fields of nuclear and space technologies are largely due to the two powerful public institutions which are in charge of these developments. 80 percent of the transfer is performed in two industrial branches: electronics and aeronautics.

The energy nuclear program does not contribute so much to R + D - transfer to industry because CEA with its filials is an "endogenous" system acting by itself. [sentence as published]

The case of the space program is different because CNES is acting actually as an "exogenous" agency. CNES has few own laboratories and centers, few own personnel, and let do outside in other institutions and mainly in companies, the most part of the development activities of which it is in charge. [sentence as published]

So that the amount of R + D resources allocated by state to technological developments in aeronautics, space, nuclear energy and defense, about 31 billion francs in 1985, is twice that of the transfer to industry, 15 billion francs, of which 11.5 billion are coming from the defense R + D budget.

That means that about 50 percent of the defense R + D budget and less than 40 percent of the civil technological developments budget are transferred to enterprises.

A great attention has to be paid in order to maintain a balance between these focused sophisticated developments and the broader programs for basic technologies dedicated to many industrial branches.

The French government is well aware of that and the minister of defense has recently set up a special commission in order to promote the transfer of technologies from R + D defense activities to traditional industrial sectors, especially small and medium companies.

ANVAR, the national agency for research "valorisation" is asked to help these

companies to take more benefit from technological development programs. This agency has supported since 1979, 9.000 innovation projects performed by 6.500 interprises, have been supported with about 6 billion francs. On the average about 50 percent of these projects are successful and give raise to return payments to the agency.

ANVAR will more and more favor small and medium sized companies which will get 80 percent of its credits in 1987 as well as the creation of new enterprises.

2.3 Direct Support to Industrial Research

Direct support goes through thematic programs funded by the "Fonds de la recherche et de la technologie - FRT" mainly devoted to basic technologies, the so-called "generic" or "diffusing" technologies so that the denomination "transfer programs" would be the most convenient according to the concept discussed previously.

The so-called "programmes mobilisateurs," launched in 1982 - 83, are in fact "integrated programs" bringing together all different actors in a common structure with a two-fold aim: to define and implement a common R + D strategy, to make closer basic research and applied developments, by programming the different projects, by avoiding double works, by a better knowledge of what is done by each other in the field; secondly, to promote a better "structuration" of the scientific and technical resources available in the field, in order to make the right connections, to establish partnerships where they are lacking, to increase the "synergies" between the different actors working in the field.

Experience has shown that such integrated programs, "institute without wall," work actually well when the dynamics is strong enough to pass over the barriers between traditional disciplines, to go through the frontiers set-up by institutions, to accommodate the secrecy cultivated by companies, the rivalities between ministries, departments.

The concept has proved its validity in the case of biotechnologies, use and saving of energy, relations between technology and employment.

But experience has shown clearly too, that some integrated programs didn't succeed to remove the structural barriers, to solve the institutional conflicts, when the balance of forces was in favor of administrative or scientific and technical feodalities.

But the reasons why they failed are precisely the arguments which support such integrated programs. The necessity remains in France for a better cooperation between institutions, disciplines and sectors which are still working too independently. "Decloisonnement" - dismantling of barriers - remains yet an unachieved but imperative goal.

2.4 Indirect Support

An interesting difference between the two countries regards modalities of indirect support to industrial research. While FRG made the choice in 1978 to support R + D personnel employment in small and medium business, France decided in 1982 to implement the proposal made in 1980 in favor of the tax credit system.

The fiscal deduction amounted 25 percent of the annual increase of R + D expenditure without afterdecrease during the next five years, within an upper limit of credit of 3 million francs per year and per company. The measure has been enlarged since 1985 by raising its rate up to 50 percent and the limit up to 5 million francs. Its impact is shown by the following data.

fiscal years	amount of credit million francs	number of credited enterprises	part of total R + D in French industries
1983	430	1700	52 percent
1984	480	2300	58 percent
1985	1,050	2700	60 percent

For the fiscal year 1985:

turn-over	number of credit enterprises	percent credit	percent expenditure	volume increase expenditure percent 1985/84	credit/ expenditure 1985
50 million F	1,400	23	6	30	14
500	900	34	19	13	7
500	400	43	75	8	2
total	2,700	100	100	11	3.7

Smaller companies take more beneift from the measure: with one fourth of the total concerned expenditure, enterprises with turn-over smaller than 500 million francs got 58 percent of the whole credit. The ratio between credit and expenditure is much higher for small and medium enterprises as for larger ones.

From a recent inquiry made by ANRT among the credited enterprises on a sample of 400 answers, 60 percent enterprises employ less than 100 persons, 56 percent never got any other support for R + D. This confirms the easier

access of such a fiscal measure for small enterprises.

36 percent "would not have performed such a large effort in R + D without tax credit." This indication is in agreement with the idea commonly admitted regarding the real yield of such measure.

It appears doubtful whether or not the measure has a positive effect on employment of R + D personnel. It seems that the incremential system which takes in charge only 10 percent of a new expenditure on five years is not in favor of small enterprises for which this amount lies below the incitation threshold.

2.5 Personnel Transfer

France employs half as much researchers and research engineers as compared with FRG per 1,000 inhabitants: 3.3 versus 7.7. About one third of the 300,000 physical persons employed in R + D in France are in public research organizations.

The important weight of public institutions is the reason why personnel must be an important component of the transfer between public and industrial research, beyond the evidence that persons themselves are the best vector to transfer ideas, know-how and results.

Since 1983 personnel working in the so-called "public scientific and technical establishments" - EPST as C.N.R.S., I.N.S.E.R.M., I.N.R.A. etc. have a derogative status of a civil servant which can be incentive to mobility for three reasons.

First, R + D people need guarantees to accept mobility. Second, mobility needs compatibility of status of personnel in the different concerned institutions; the new status of EPST's researchers is exactly similar to the status of professors in universities.

The third reason is that the civil servant status gives precisely very large administrative possibilities for personnel to move in other sectors without having to resign their public position: setting at disposal, in detachment, in vacancy.

Research institutions have now to make use on a large scale of these possibilities.

Departures outside public research during the seventies were more frequent because many scientists were leaving C.N.R.S. at senior stage to become professor in a university: the average rate was about 2 percent, it has progressively decreased down to about 0.5 percent.

But mobility is increasing again and should increase very much until, instead of a few hundred people, several thousands could work in production and education sectors. Professional judgement criteria have to put value on such movements in order to encourage them.

C.N.R.S. has since several years transferred to industrial sectors several complete research teams to build up new mixed laboratories in common with enterprises inside them.

The new public R + D personnel status is opened to reverse mobility from industry to public research. A new position of "associated research director" gives the possibility to research seniors of industry to perform a part of their activities during one or two years in C.N.R.S. laboratories.

3. Interface Between Research and Education

3.1 C.N.R.S.-universities - "grandes ecoles"

The three-fold splitting of the higher education and research sector between C.N.R.S., universities and "grandes ecoles" is a result of the former reluctance of university in France for new disciplines and for engineering sciences. So that have been sucessively created outside universities the high engineers schools and C.N.R.S.. [sentence as published]

C.N.R.S. manages 1,300 research units among them 350 own ones and 950 "associated," 750 in universities and 250 in high engineers schools.

One third of the 45,000 universities' scientists are working in laboratories associated to C.N.R.S. or in its own laboratories. C.N.R.S. and universities are indeed closely integrated. C.N.R.S. gives about 60 percent of its research credits to its 750 research laboratories in universities. Regarding research credits without salaries C.N.R.S. got this year 2.2 billion francs and the Research Directorate of Education ministry 1.5 billion francs. Research in universities receives money from the both sources.

Regarding the high engineers schools, they have increased their expenditure on R + D, salaries included, up to about 1.4 billion francs in 1984 and they employed 5,600 persons in research activities.

3.2 Research Training

The number of doctoral grants for post-graduate studies has been increased from 1,500 in 1981 up to 1,900 every year since 1985. About 20 percent of these grants are assigned to engineers.

In order to increase the industrial R + D, an additional effort has been made in direction of engineers and enterprises, with the so-called "contracts of

research training for industry" (CIFRE) associating state and enterprises as well in paying salaries as in carrying out research: 400 every year now.

Altogether about 1,000 doctoral grants are allocated every year to engineers among the 12,000 ones coming out of the schools (600 in 1980); the ratio is about 8 percent. This figure is comparable with those of other similar countries. But a large fraction of engineers do not chose to work in industry after they got their doctor degree. Therefore doctorate must not be the unique way to supply industry with engineers trained by research.

3.3 Higher Education and Integrated Research

Students do not get enough experience of research in France during their graduate studies. There is no equivalent to the German "Diplomarbeit [graduate diploma]." Such a research integrated in graduate studies is very often closely related to industry and the lack of interest for such limited but concrete research projects in France might be one reason for weakness of technical and cooperative research.

A step has been made in order to improve this situation by creating in 1984 new Centers for engineer training by research to technology (FIRTECH) taking as model the Industry university cooperative research Center in USA. Bringing together universities, engineer schools and industry, 10 FIRTECH poles exist now, each of them devoted to basic technology.

Conclusion

Very shortly, such an analysis of the French R + D emphasises the importance of interactions of the R + D - system with two surrounding sectors: transfer to industry and integration with higher education. Less attention is generally paid to personnel policy than to funding, but qualification and use of people are actually two key words of this topic.

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CNRS CHIEF EXAMINES R&D LINKS WITH INDUSTRY, EUROPEAN PARTNERS

Paris ENJEUX in French No 80, May-June 87 pp 33-36

[Article by Serge Feneville, director general of the CNRS (National Center for Scientific Research): "CNRS: A Partner for Companies"]

[Excerpts] It is true that relations between industry and the research world have been unclear for a long time. Today, the CNRS [National Center for Scientific Research], with the experience acquired by the 1,300 laboratories either owned by it or associated with it, intends to change this situation. Signs of a certain evolution are already perceivable: evolution in the mentality of the various partners concerned, and an evolution in the relations between researchers and industry.

The first joint laboratories were launched in 1986, and the medium-term objective is to create about 50 of these. Ten already exist today, working in such diverse fields as the oil sector, medicine, and the new sector of synthesis materials. These joint laboratories are responsible for creating a partnership between companies--either manufacturers or service companies--and the CNRS for specific industrial projects. In this way, these contracts make it possible to implement short- or medium-term programs defined on the basis both of specific technical problems encountered by manufacturers and of research possiblities. As a general rule, the cost of the work is divided between the CNRS and the company.

Until now, this type of laboratory dealt primarily with large companies. To be more precise, we should perhaps say that collaborative agreements of this kind are effectively made with one of the divisions of these major firms, which itself may resemble a medium-sized company. If we take Rhone-Poulenc as an example, we can see that there are several joint laboratories working in totally different directions. What usually happens is that the agreements are made with the individual divisions rather than with the group as a whole.

Why is it that until now, small companies have only very rarely been involved in this type of collaboration? The reason is simple: the majority of these small companies do not have the level of scientific or technical support required for the implementaton of joint programs.

Given this, the idea of joint laboratories had already been simmering for several years. Agreements were reached in the form of contracts and grants;

in other words, in the form of interventions that were much harder to identify--or if you prefer, which had far less media impact. The very concept of a joint laboratory is far better received by manufacturers; from our point of view, it lies at the heart of an idea which we are seeking to promote: the concept of partnerships.

Partnerships, partners. These are important words because for a long time now, relations between the CNRS and industry have been ambiguous in several respects. First, certain manufacturers regarded CNRS laboratories as subcontractors, and this led to the use of unsatisfactory methods and criteria for evaluating research. Undoubtedly, a company may find it advantageous--in the short term at least--to obtain services at a low cost, but this inevitably has negative effects on the laboratory. The second ambiguity originates with the CNRS itself, which for some time attempted to control its own industrial development, and this again was not very satisfactory.

In order to put an end to these ambiguities, we coined a slogan: "the CNRS, a partner for companies."

For all the manufacturers I come into contact with--and there are a great many of them--this new policy has a real significance. They now regard us as genuine partners, rather than simply as customers or suppliers. They know that it is important for us to implement joint projects, through laboratories or through major collaboration contracts.

With its 1,300 laboratories, the CNRS may appear to be the privileged partner of the PME's [small and medium-sized companies]. To strengthen the links with these PME's it will obviously be necessary to break away from the bad habits inherited from the past. These consisted primarily of decisionmaking at the highest hierarchical level and then transmitting these decisions to the grassroots level, that is, the laboratories. Personally, I believe that it would be better if things were handled directly by the PME's and the laboratory, which operates as a small company--and I know what I am talking about here because I have directed one. This direct approach already exists, despite the fact that it often breaks the rules we have established for ourselves, some of which are overly restrictive.

Work in the Scientific Sector - National Stakes

The crux of the problem--and I can assure you that it is a very real problem--is the fact that there are not enough managers with an adequate scientific background. This is a problem affecting the majority of the PME's, including those working in the advanced technology sector. For a PME, this inadequacy constitutes a major handicap which often prevents it from establishing a genuine dialog with the pure research laboratories. This problem involves the entire sphere of scientific work in France, not just the use of researchers in state organizations, but scientific work in the whole of our industrial fabric. If we draw a comparison with the situation [in other countries], particularly the FRG, the situation in France looks extremely worrying. We cannot just be content to have brilliant research directors in the

laboratories of large companies; we have an overriding need for managers of PME's--and a large number--with a research background. Managers who know what a research laboratory is; managers who, in addition to product problems or market problems, are capable of perceiving improvements that would allow them both to reduce costs and to upgrade product quality. This necessary evolution of work in the scientific sector in France represents major national stakes.

Moreover, it also could be seen as a stepping stone that will bring the CNRS closer to small companies.

In effect, the question is this: how can we promote collaboration between research and industry at the level of PME's and PMI's [small and medium-sized industries]? A structure exists that could help us and with which we have had a grat deal of contact. This structure is constituted by the Chambers of Commerce, which form a good link between companies and the CNRS laboratories. However, we need to go still further. Alain Madalin and Jacques Valade, the industry and research ministers, are currently working together on the joint aid which should be given to certain companies to develop innovation. This type of incentive, which our neighbors in the FRG have had for the past 10 years or so, has made it possible to put several thousand scientists into small companies. This aid consists of offering these companies the opportunity of hiring a manager with a scientific background for 2 or 3 years--according to their level--with the salary being paid by the state. Moreover, it is interesting to note that in this process, the FRG authorities are not permitted to pass judgement on the contents [of the work] in any way at all. Since this aid is included in the general budget allocated to these operations, any company requesting this type of aid will receive it, regardless of whether it is involved in traditional sectors or in a leading edge technology sector.

I do not know whether the French government will follow this example. Whatever happens, though, we urgently need to find solutions in order to increase the movement of researchers to companies, particularly the PME's and the PMI's. We cannot hide the fact that this lack of mobility represents a great failure on our part today. The reasons for this failure have been analyzed repeatedly and are well known. Some of them go back a number of years, while others are the result of circumstances. However, the most serious problem is essentially one of administration.

Promoting Mobility of Researchers

Many state service regulations are designed to ensure that state employees remain in the state service. This objective is the opposite of ours, which seeks to ensure that as many researchers as possible move to business and industry. To achieve this objective, we would have to obtain special dispensations from the state service system, primarily in connection with pensions, supplements to salaries, etc. So many elements represent administrative barriers obstructing this mobility.

There also are psychological reasons, and this is something with which I have had first-hand experience. I worked as a researcher for the CNRS for 20 years. After this I worked for Lafarge Coppe for 5 years. This move made me

aware of the extent of the cultural gap separating the state research sector from that of industrial research. To promote the movement of researchers to industry--and in my opinion there are more candidates than one would imagine--specific training programs have to be implemented in order to prepare these candidates culturally for a move about which, I must emphasize, there is much to be learned.

Like any company, the CNRS has a permanent training program. Within the framework of this program, we have allocated a certain sum as of this year to business-oriented training. Our objective in doing this was twofold: first, training for people who want to join an existing company; second, training for those who want to set up their own company. For 1987, the scope of this work will remain fairly limited. Training is something which has to be offered; it cannot be forced on people. First and foremost, we want to see how the scientific community reacts and how it will respond to the opportunity we are offering it to help prepare for [greater] mobility.

We aim not only to promote the movement of researchers to companies, but also to increase the movement of engineers working in industry to the research sector. We have already created [a number of] positions for associate research directors, and we are firmly determined to go further. For 1988 we hope that our supervisory body will allow us to have engineers coming from industry work in our laboratories as part of their permanent training, not so much to do research as to learn the leading edge techniques we develop. The cost of this training will be borne by the training budget of the company. It is, in fact, in pure research laboratories--for example, those involved in space research or particle physics, whose objectives are distanced a priori from the objectives of industry--that highly sophisticated techniques are developed which can then be used in industry. On the one hand, we have researchers who are not really interested in the development and industrial application of their techniques, while on the other hand we have engineers coming from industry who are often unfamiliar with the techniques in question. It is therefore essential that they meet with one another and work together, since this will put them in a better position to translate this research into technological innovation. We must not forget that in the 1960's and 1970's the leading world experts in data processing were to be found doing research on particle physics. There was a very good reason for this, namely that the first advanced data processing [technique] was developed in these laboratories.

Active Participation in EC Research

Cooperation between industry and the research world is therefore essential, and has a very special role to play not only in the context of increased international competition but also within the prospect of a future united European market. In connection with this internal market, the CNRS firmly believes that the only possible approach is a European one. Today, it is quite clear that our countries are no longer large enough to meet the scientific and economic challenges that will emerge over the next few years. But [a united] Europe is not an easy thing to accomplish: there is no one way in which it can be achieved. This is why we are working in the most diverse directions.

Our laboratories are obviously involved in all the European programs and they are all absolutely free to cooperate in these programs. Within the framework of the EUREKA program, the CNRS laboratories--or laboratories associated with the CNRS--play a major role in the various program areas regardless of whether French industries are represented in these areas.

Finally, in addition to these programs and projects, we are constantly in contact with our European counterparts through agreements, contracts, and so on. However, we would like to broaden these contacts on the basis of [possible] partnerships, establishing joint laboratories with them.

Let us take Alsace as an example. This region plays a very special role within the economic area that we referred to as the Rhine basin. Given the linguistic advantage--Alsace is much more pro-German [germanophone] than the rest of France--it would be possible to establish preferential relations among the laboratories located on either side of the Rhine. Another example is our British friends, with whom we have regular meetings on topics of common interest. Meetings are held between groups of French and British researchers who discuss these subjects and submit proposals to us for joint action. Here again, it would be possible to establish joint laboratories.

The last aspect of this European cooperation concerns the large-scale equipment that the scientific sector is increasingly tending to construct today in almost all fields. The very size of this equipment means that by definition it has to be European. One even wonders whether scientific equipment will be world equipment by definition within a decade or so. But that is another question. What we have to do today is to ensure that we have European equipment and instruments available.

The synchrotron we are now constructing for the production of X-rays is a good example. This will be used in the sectors of biology, physics, chemistry among others. We are working in partnership with the FRG, Britain, Italy, Spain, Norway, and now with Switzerland as well. These large instruments will play a decisive role in creating a European scientific community. The researchers are working on this as a united team, and are truly making [a united] Europe.

The CNRS--10 Percent of World Research

I would say that research is by its very nature international. Each researcher goes abroad at least once a year. The congresses are international, as are the [scientific] reviews. Within the framework of international competition, the CNRS upholds the position of France in the world. Whether you use the GNP principle, the principle of exchange rates, or any other parameters that describe a major nation--apart from population parameters, obviously--France represents approximately 10 percent of the OECD. As for the CNRS, it accounts for 10 percent of world activity in pure research. We therefore maintain the position that is ours. Having said this, we also must say that the great programs we knew in the heyday of UNESCO concerning

the creation of deserts, forests, etc., no longer exist today. This is essentially the result of the difficulties these major international organizations have experienced for some years now. You know as well as I do what has happened to UNESCO. The sorts of pressures brought to bear mean that strictly speaking one is no longer dealing with the scientific sphere.

There also are examples that demonstrate the opposite, notably the major world program to study climate. Clearly, this study can only be conducted at the world level; you simply have to look at a satellite photo to understand this. France is in a particularly good position in this field following the purchase of the supercomputer, named CRAY 2, which we share with the Ecole Polytechnique and the National Meteorological Office and which enables us to do excellent work.

Thanks to its high level of researchers and laboratories, the CNRS fully maintains its position both in Europe and at the world level. The quality of the organization's work makes it a vast reservoir of knowledge, expertise, and know-how. What we must now do is ensure that both small and large companies can draw greater benefit from all this by demonstrating to them that the CNRS not only wants to be a dynamic partner, but is also capable of being one.

[Box insert, p 34]

Research-Industry Cooperation

Company: Jumelec, small company located at Nozay (Essonne).
This company primarily develops materials and systems for biomedical applications.

Examples
--a system for data acquistion and high performance control to respond to the problems posed by cases of cardiac and respiratory failure; developed through cooperation with the Laboratory of Cellular and Molecular Neurology of Gif-sur-Yvette
-an amplifier for registering electropyhsiological signals in response to problems concerning the knowledge of cerebral activity and for cerebral medicine; developed in collaboration with the Signals and Systems Laboratory (CNRS/Supelec Joint Unit).

[Box insert, p 35]

Creation of a Company by a Researcher

Laboratory: Molecular and Macromolecular Laboratory - CNRS unit located at Thiais. Research field: microwaves.
This laboratory has numerous relations with companies in the most diverse fields involving microwave applications.
Examples:
--cooperation with Bull for drying ink in high-speed printers;
--cooperation with Regie Renault: a microwave network used for the combustion of organic particles "trapped" by a ceramic filter in catalytic exhaust pipes.
N.B.: Two years ago laboratory head Andre-Jean Bertaud established the

company MES (Micrwave Energy System) located within a business area at Orly. Today this company employs eight people, one of whom came to the company through CNRS. The major development areas of the company, which works in close collaboration with the laboratory, are two drying systems, one for the agro-industry and the other for the drying of waste from nuclear power stations.

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BRITISH OFFICIAL OUTLINES S&T POLICIES, ORGANIZATION

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[Paper presented by Dr Ronald Coleman, chief engineer and scientist of the British Department of Trade and Industry (DTI), at international conference on "The Organisation of Science and Technology in Western Industrialised Countries--An International Comparison" in Bonn, 26-27 May]

[Excerpt] Introduction

In this presentation I intend to concentrate on the way in which the UK's S&T policy is organised, with particular emphasis on the 'T', technology, aspect, since this is of most relevance to my own responsibilities. I propose to begin my lecture by summarising the distribution and amount of Government funding for R&D and by describing the most important aims of that expenditure. I will then go on to indicate the mechanisms which the Government employs to assist the R&D policy-making process before describing different areas of R&D policy in more detail.

There is no single, overall research and development budget in UK Government expenditure planning. Each Department determines its own R&D programmes in support of its policy objectives and in the light of its own priorities. Decisions on the level of expenditure on R&D are made during the Government's annual public expenditure survey. The total amount spent by central Government on R&D, nearly over 4.6 billion pounds sterling in 1985/86 is thus the sum of all Departments individual expenditure on (Frascati) R&D activities. This total represents an increase in net expenditure on R&D by the Government of about 10 percent over the last decade. Net expenditure on R&D has been rising steadily since 1982/83.

It is possible to indicate how the UK Government funds R&D by breaking down R&D support in a number of ways. The Government publishes a document each year, the Annual Review of Government Funded R&D, which provides a comprehensive breakdown of R&D funding. This analyses R&D support according to a) objectives, b) types of activity and c) distribution between Departments.

Aims and Distribution of Government R&D

Although each Department undertakes its own programme of R&D, the primary aims of these programmes can be analysed collectively:

--Primary purpose one of Government R&D is the advancement of science. This is work funded primarily in order to increase human knowledge and with no specific application in view. This heading is roughly equivalent to the OECD term 'basic research' which I will return to later, and accounted for about 17.6 percent of total Government funded R&D in 1985/86.

--Primary purpose two is support for policy formulation and implementation. This involves applied research and experimental development carried out in order to meet the Government's own needs for knowledge or improved products or processes and accounted for 8.4 percent of Government expenditure on R&D in 1985/86.

--Primary purpose three is the improvement of technology. This is work funded by the Government but often carried out within industry to advance the technology of different sectors of the UK economy. It accounted for over 19.8 percent of Government expenditure on R&D in 1985/86.

--Primary purpose four is support for procurement decisions. This is applied R&D which contributes to the development of goods and services required by Departments (mainly related to defence needs) and accounts for 51.4 percent of Government R&D.

--Primary purpose five is support for statutory duties--i.e., applied R&D which assists Departments to carry out statutory responsibilities and other obligations. This takes up 1.7 percent of Government spending on R&D.

--The sixth purpose is support for those activities which cannot be classified under any of the previous headings. This is relatively minor heading, accounting for just over 1 percent of the total Government support for R&D.

Alternatively, UK Government R&D spending can be analysed by describing the type of activity undertaken according to definitions in the Frascati manual. This breakdown indicates that a wide spectrum of R&D is funded by the Government ranging from basic research, which received nearly 18 percent of the total Government support in 1985/86, to experimental development, which in the same year accounted for just over one half of the total Government expenditure on R&D. (A more complete breakdown is illustrated on the viewfoil) [not shown]. Additionally, the Government undertakes some non-Frascati R&D activities-advisory and consultancy services and awareness programmes, for example. I will be able to describe these when I turn, late in the lecture, to my own Department's R&D activities.

A large number of Government Departments are involved in R&D activities. The Ministry of Defence is the most important of these, receiving, in 1985/86, just over one half of the total Government support for R&D. The Research Councils and the University Grants Committee received just under 12 percent and 14.6 percent respectively to maintain the UK Science base and the remaining Government funding (21.5 percent) was split between the Civil Departments, as the viewfoil shows [not shown]. The Department of Trade and Industry's share represents 8 percent of the total. I will return to discuss this in more detail later.

R&D Manpower

The Government has no figures readily available which provide a comprehensive picture of the total number of people employed in R&D work across all sectors in the UK. However, figures are collected as a part of the Annual Review exercise which indicate the number of people employed by the Government and working intra-murally in the Departments and Research Councils. Government funding of R&D extends much wider than this, to work which is done in industry and in the universities, for example. The employees engaged in this work will be funded from a variety of sources, so the following figures do not offer a complete analysis of R&D personnel employed as a result of Government funding.

In 1985/86, just under 57,000 people were employed intra-murally by the government, about one half of these by the Ministry of Defence. 30 percent of the total were employed at degree-level or equivalent, with a further 15 percent at technician level.

In addition, my own Department carries out a 'Benchmark Enquiry' every four years into the number of people employed in R&D activities in UK Industry. Provisional figures for 1985 show that 157,000 personnel were engaged in R&D work in industry of which about 46 percent were employed at degree level or equivalent, and 28 percent at technician level.

Performing Sectors of UK R&D

In the UK, the Government funds around 48 percent of all the R&D work carried out. Industry contributes about 44 percent of the total funds for R&D, with the remainder funded by public corporations, research associations and others. In terms of who carries the R&D out, industry is the most active; 63 percent of all R&D work is performed in this sector. 23 percent of R&D is carried out by Government Departments and organisations and 11 percent by higher education institutions. (The pie charts on the accompanying viewfoil should serve to clarify the distribution) [not shown].

Organisation of R&D

Although the UK has no single Minister or Government Department with

responsibility for science, there are a number of mechanisms which exist to ensure that R&D is properly co-ordinated across Government.

(i) Select Committees exist in order to scrutinise and advise Parliament on the activities and policy of Government Departments. There is a House of Lords Select Committee which looks specifically at S&T, and which published the results of an enquiry into civil R&D in January of this year. The Government is currently preparing a response.

(ii) Ministers meet regularly to consider R&D issues collectively.

(iii) Central Government expenditure is determined in the Public Expenditure Survey, the results of which are published. This primarily involves negotiation between individual Departments and Treasury. The amount of expenditure on R&D is part of each Department's overall spend plans, but is also discussed separately with Treasury.

(iv) At the official level, the Chief Scientific Adviser to the Cabinet Office and the Departmental Chief Scientists meet regularly and there is also regular discussion at lower levels.

(v) I have already mentioned the Annual Review of Government-funded R&D. This seeks to establish a database of all Government funded and is increasingly assisting policy decisions. [sentence as published] It also looks at trends in the private sector and contains international comparisons.

(vi) An important recent development has been the establishment of a Science and Technology Assessment Office, located in the Cabinet Office and under the control of the Chief Scientific Adviser. This office will develop evaluation methods for assessing the contribution Government Support for R&D makes to the efficiency, competitiveness of innovative capacity of the UK economy. It will also work with Departments to advise on the content and conduct of their R&D programmes and will advise Ministers collectively on the relative priorities between R&D programmes.

The Science Budget

Concentrating exclusively on Civil R&D, much of the science base is maintained by means of the Science Budget which is administered by the Secretary of State for Education and Science. Research carried out by the universities plays a vital part in maintaining the Science base. Money comes from the Science Budget to the universities in two ways, constituting what is called the 'dual support system.' Some research is financed by RC grants and funds from other external sources, including charitable trusts and

foundations, but the main support comes from general university funds deriving from the University Grants Committee. The UGC allocates resources to universities in the form of block grants. UGC funds are intended to provide the basic 'floor' of research capability in university departments which is necessary if speculative ideas are to be generated and developed to the stage where they may attract support from external sponsors. Recently the UGC has been adopting a more selective approach in allocating funds for research.

The remainder of the Science Budget is disbursed by the DES almost entirely as grants in aid to the five Research Councils - the Agricultural and Food Research Council (AFRC), the Economic and Social Research Council (ESRC), the Medical Research Council (MRC), the Natural Environment Research Council (NERC), and the Science and Engineering Research Council (SERC). The Research Councils collectively receive over 80 percent of their income from the Science Budget with the rest coming from other Government Departments for commissioned research. The Councils have four fundamental responsibilities - the advancement of knowledge, the maintenance of a national research capability, postgraduate training, and the achievement of practical benefits. In 1985/86, 26 percent of the Science Budget was used for research grants, 13 percent for postgraduate awards and 34 percent for the support of institutes and research units. The balance was accounted for by international subscriptions, capital and administration.

The Advisory Board for the Research Councils (ABRC) was set up in 1972 and exists to advise the Secretary of State for the DES on the resources needed for science and on the division of available funds within the Councils. The ABRC also acts for the councils collectively in presenting the case to the Government for the support of science. Its membership includes eminent scientists, academics and industrialists.

Customer/Contractor Principle

The customer/contractor principle was originally set out in the Rothschild Report and subsequently implemented by the Government in 1972. Under this principle, Government Departments are placed in the position of customers for the research they need:- "the customers says what he wants the contractor does it (if he can) - and the customer pays." Funds which had previously been received by the Research Councils were reallocated instead to the Government Departments concerned with the research undertaken by the Councils. The principle applies only to applied R&D, since the Government recognises that there is no analogous customer/contractor relationship for basic research. The Government also accepted Lord Rothchild's recommendation that an average surcharge of 10 percent be placed on R&D contracts to meet the need for 'general research' by the Councils. A government review of the changes in 1979 concluded that they have strengthened the Government's R&D machinery.

ACARD

The Government is advised on its policy for applied R&D by ACARD, the Advisory Council for Applied Research and Development. Members of ACARD are drawn from outside Government and are mainly senior industrialists and academics. The Council is currently seeking to establish an 'Exploitable Areas of Science' body, following its report, published in 1986, which indicated that a mechanism was needed to identify scientific developments with the highest potential for economic exploitation. It is envisaged that this will be located outside Government and will take its membership from Industry and from Government.

DTI R&D - Aims

I hope that I have managed to communicate some idea of how UK R&D policy and support is administered across Government. I would now like to move on to discuss that area which most concerns me, as Chief Engineer and Scientist designate to the DTI, the funding of industrial R&D.

The Secretary of State for the Department of Trade and Industry has responsibility for about 15 percent of the Government's funding of civil R&D. The central aim of the DTI is to encourage, assist and ensure the proper regulation of British trade, industry and commerce; 'to increase the growth of world trade and the national production of wealth.' Support For Innovation is one of the three main ways in which the Department achieves this (the other two being by improving the economic climate and international competitiveness), and this element of DTI policy has become increasingly important over the last 10 years. In 1977/78, the DTI spend on R&D was 100 million pounds sterling, or 9 percent of the total budget. 412 million pounds sterling has been set aside for R&D in 1987/88, which is about 40 percent of total DTI expenditure. The increase in real terms on R&D expenditure since 1979 has been about 60 percent.

The aims of DTI's Science and Technology policy are to encourage and assist:

(i) increased civil R&D in industry
(ii) effective exploitation of UK and foreign S&T
(iii) awareness and rapid adoption of key technologies
(iv) levels of quality and design that match the highest world standards
(v) closer co-operation on new products between UK producers and customers - for example through public purchasing.

DTI R&D - Rationale

The devising and financing of industry's R&D programmes must, of course, be largely for industry itself since these are commercial decisions which should primarily be governed by market forces. Indeed, the bulk of industrial R&D is

financed by industry from its own resources - 2.9 billion pounds sterling in 1985 (provisional figure). However, there are circumstances where defects in the market mechanism may mean that DTI support for industrial technology can secure net economic benefit to the nation. For example, where projects, though economically attractive, are too risky to firms for them to go ahead by themselves, because the timescales are too long or technical risks are high, or where the potential beneficiaries of the R&D results are too diffuse for any one company to undertake the R&D unaided.

DTI - Advisory Bodies

The DTI receives advice and assistance from a number of organisations, internal and external, in developing and implementing its policies. Like other Government Departments it gives careful consideration to the advice of ACARD and the House of Lords Select Committee on Science and Technology. In addition, just as the ABRC advises the SoS of the DES on the Research Councils, so the DTI has its own advisory group. The Technology Requirements Board (TRB) is made up of industrialists and advises the Department on overall strategy and on priorities for R&D support. The TRB is chaired by a senior industrialist and is supported by specialist advisory committees of industrialists and academics and pays particular attention to how individual projects will be exploited.

The development and implementation of policy and the administration of the budget is through a committee of officials, the Science and Technological Assistance Management Group (STAMG), chaired by DTI's Chief Engineer and Scientist. In addition, the Department takes advantage of trends in, and perceptions of, the market through a wide range of contacts with firms, trade associations and representative industrial groups such as the National Economic Development Organisation and the Economic Development Councils. The Department's Industrial Development Advisory Board (IDAB), which consists of independent industrialists, bankers, accountants and financiers, is consulted on specific issues and prospects.

DTI - Intramural Expenditure

So far, I have indicated in general why the DTI supports R&D and how it organises that support. Now I will move on to describe in detail how available funds are distributed without the Department, as well as the kind of R&D activities that the DTI supports.

Expenditure by the DTI on Support For Innovation in industry covers both extramural support for R&D carried out by industry and a small, (about 3 million pounds sterling), but important element of intramural expenditure within the Department's own Research Establishments.

Intramural expenditure carried out by the DTI's own RE's accounts for about 8

percent of DTI's R&D expenditure. This contributes towards work required by statute, the national measurement system, specification standards, Government planning and regulatory functions, Departmental policy initiatives and work carried out for the national benefit.

The results of all these activities are then transferred to industry by various means, including the provision of expertise and services to industry as repayment. All the laboratories set up collaborative or 'club' projects which are a key element in this transfer of results to industry. Such projects have a broad-ranging membership from industrial, research and university organisations and are an important means for defining programmes to meet industry's perceived needs. Each RE has its own intramural R&D programme and specific objectives.

(i) The Laboratory of the Government Chemist (LGC) carries out R&D in the area of chemistry to support specific Departmental policies and to underpin the statutory role of the Government Chemist. It is active in the important technologies of chemical sensors, the new area of biotransformation, new materials, and the use of robotics and automation in laboratories.

(ii) The National Engineering Laborator carries out R&D in a wide range of engineering and related disciplines. It maintains the UK standards of flow measurement which are especially important to the oil and gas industries.

(iii) The National Physical Laboratory is the focus of the National Measurement System. It maintains measurement standards and co-ordinates these with our trading partners in order to reduce barriers to trade.

(iv) Warren Spring Laboratory carries out research in environmental and industrial process technologies serving both Government and industry. The primary objective for the DTI funded R&D at WSL is the enhancement of the technological base of the UK process industries.

DTI - Type of Support

Although intra-mural support represents an important aspect of DTI funding of R&D, the vast majority, 92 percent, of support is extra-mural. This support falls under 3 main headings:

(i) Support for projects undertaken by individual firms

(ii) Support for projects undertaken on a collaborative basis

(iii) Support for activities concerned with:

--improving technological skills, both in industry and education
--helping the transfer of technology from research to the market place
--providing advisory and consultancy services
--spreading awareness of existing technology, for example through demonstration skills.

The Department's non-Frascati support for R&D, i.e., these activities listed under the third heading, accounted in 1985/86 for about 16.5 percent of total DTI expenditure.

Following a review of the Department's support for industrial R&D, a change in the pattern of support was announced in March 1985. The main thrust of the change was that a greater proportion of the Department's support would be made available for collaborative research, advisory services and schemes for encouraging best practice and improving key skills. Less support would be given to projects in individual companies and the criteria for such support would be tightened. Over the period 1984 to 1989 single project support is set to fall by over 50 percent while support for collaborative projects and for non-project activities is planned to double. The aim is that resources should be targetted towards those activities which offer the greatest leverage from limited funds and which have the most widespread impact across the economy. There has therefore been a switch in emphasis in DTI from Frascati to non-Frascati activities.

DTI Non-Frascati R&D-Related Activities

DTI expenditure on non-Frascati R&D related activities amounted to 72.4 million pounds sterling in 1985/86. The Department's review of its R&D support indicated that in these areas the benefits ext beyond the individual firm or project concerned and help to creat environment conducive to innovation; as a result, it is now DTI policy to increase its non-project support.

(i) The DTI uses a narrower definition than that normally understood of technology transfer, which restricts the term to activities which promote technology transfer by encouraging the movement of qualified people from one organisation to another. The major initiative of this sort is the Teaching Company Scheme, jointly supported in conjunction with SERC, and industry, and towards which the DTI contributed 3.1 million pounds sterling in 1985/86. The Scheme aims to transfer technology and train high quality graduates for careers in industry by forming active partnerships between academic institutions and firms; the graduates receive two year associateships during which they work in the company concerned. Over 250 companies and 50 academic centres around the UK are currently involved in some

200 different programmes.

(ii) DTI spend over 9.8 million pounds sterling in 1985/86 on industry training and education. Under the Micros in Schools Scheme (now ended) schools were given the opportunity to purchase a microcomputer at half price. The Software in Schools scheme, commenced in 1985, follows on from this initiative. Information Technology Centres have been set up in 175 locations in the UK in which unemployed 16-17 year olds are provided with training and work experience in micro-electronics and computing skills. The Engineering and Technology Programme, more popularly known as 'The Switch,' is a 43 million pounds sterling programme designed to provide 5000 extra higher education places in S&T. DTI will contribute 12.5 million pounds sterling over 3 years.

(iii) Advisory and Consultancy services is the most important area of DTI non-Frascati support and accounted for 37 million pounds sterling in 1985/86. The DTI sponsors a package of advisory services which provide subsidised consultancy on design, productivity and quality management to firms with up to 500 employees. It is hoped that this will encourage SMEs to adopt best practice techniques.

The Department also offers support in the field of MAP and AMT consultancies, in order to encourage the use of microelectronics in UK industry and to ensure that AMT is exploited to the maximum.

(iv) DTI expenditure on the application of awareness of new technology amounted to 10.65 million pounds sterling in 1985/86. The Department has an active design promotion policy which is largely carried out by the Design Council. A Computer Aided Design, Manufacture & Test (CADMAT) programme aims to enhance the knowledge and encourage the application of computer aided techniques in the UK electronics industry. The Department's Overseas Technical Information Service has the objective of distributing to the UK Government and industry scientific and technical information gathered overseas by our embassies and by the British Council.

(v) Remaining non-Frascati expenditure of over 11 million pounds sterling in 1985/86 was spent on miscellaneous activities, most importantly the public sector to use it purchasing power to help demonstrate innovation UK and processes in the market place. (sentence as published)

DTI - The Role of Collaboration

The benefits to be gained through collaboration between Government, industry, higher education institutions, Research Councils and Research

Organisations have become increasingly apparent. Collaborative research necessarily involves sharing and spreading technical information and expertise between partners, often including both academic and industrial organisations. The DTI has therefore given collaborative projects a higher priority in its funding of R&D.

The Alvey programme in Information Technology is collaborative programme which brings together DTI, MoD, SERC, industry and HEI's in collaborative projects in four areas of information technology: intelligent knowledge based systems, software engineering, very large scale integration and man/machine interfaces. It is estimated that, as a result of Alvey, there is now no single UK university IT research department of any standing which is not involved on collaborative R&D with UK industrial partners. Alvey is a five year programme initiated in 1983, with an overall budget of 350 million pounds sterling of which more than half will be provided by the Government. Its objective is to ensure that the UK maintains an internationally competitive position in advanced IT towards the end of the century. There have been two hundred projects to date with an average of four partners per project, each with typically two or three firms and one or two universities.

LINK, a major new initiative announced by the Prime Minister at the end of 1986, aims to stimulate collaborative research programmes between Industry and the HEI's RC's and other research establishments. The intention is that LINK will bridge the gap between science and the market place by focussing on advances in the science base which can be exploited commercially. It is envisaged that Government funds will build up to 210 million pounds sterling by 1990/91, matched by similar funds from industry.

The Joint Opto-Electronics Research Scheme has led to industry and HEI's establishing projects at the pre-competitive stage of research into opto-electronics. The take-up of funds has been rapid and the success of the scheme has led to DTI and SERC making additional funds available in order to maintain momentum in this important area of technology.

International Collaboration

There is a clear and long recognised need for the UK to collaborate internationally on technological matters, not least because about 95 percent of the world's R&D is performed outside the UK. The benefits of international collaboration on R&D can be considerable; costs per participant are reduced; the risks associated with advanced technologies are more widely spread; new markets are easier to open and establish; or European R&D can more easily achieve the scale needed to compete with the US and Japan. The growing recognition by UK industry of the importance of European collaboration is illustrated by enthusiasm for ECR&D programmes such as BRITE, ESPRIT and RACE whilst the EUREKA initiative has enjoyed rapid growth.

The UK played a major role in shaping EUREKA, whose primary purpose is to promote collaboration on projects aimed at producing competitive goods, products and services for markets worldwide.

The number of projects announced so far is 108, with a total value of 2.6 billion pounds sterling. The UK is participating in 40 of these projects (worth a total of 0.9 billion pounds sterling), and these involve some 80 UK organisations, of which about 20 are small and medium sized enterprises.

Although it is too early to guage accurately the effectiveness of EUREKA, indicators point towards positive results emerging in terms of marketable goods and services. A growing number of UK firms see their future in Europe, partly stimulated by initiatives like ESPRIT and EUREKA, and recognise the importance of collaborating with other European partners if they are to remain competitive, open up market opportunities and survive - perceptions which, judging for example by continuing commitment to EUREKA, are shared by firms and Governments in Germany and elsewhere.

Evaluation

It is vital, given that only a limited amount of Government funds can be made available for R&D, to ensure that value for money is being obtained from public support. Because of this, the Government has become more committed to evaluation as a means of measuring whether that value for money is being achieved. The Government's desire to improve its evaluation of R&D expenditure has resulted in the establishment of the Science and Technology Assessment Office in the Cabinet Office, which I mentioned earlier. Within the DTI, too, there has been a move towards greater emphasis on evaluation of S&T expenditure. Since mid-1984, the DTI has strengthened its resources for and its organisation of evaluation. A permanent evaluation group has been set up to determine priorities within a rolling evaluation programme; to assess complete studies and bring them to the attention of the Department's S&T committees and Ministers; and to ensure that the rationale and criteria for all S&T expenditure proposals meet Departmental standards. Evaluation studies are carried out using a mixture of internal resources, including technologists and economists, and external consultants.

A considerable body of evidence is now available on the effectiveness of DTI schemes. Evidence suggests that successful innovations are characterised by thorough-going market appraisals and repeated interim reviews involving company representatives dealing with R&D, production, finance and marketing. These findings are being incorporated into Departmental guidelines governing future S&T support. The Department regards its appraisal procedures as an essential step in securing good value from its public support for S&T.

Conclusion

In the course of my talk this afternoon, I have reviewed for you expenditure by the UK Government on R&D and related activities and I have also given an indication of the level of total R&D activity in my country. It is always difficult to understand the mechanisms of Governments in other countries but I have tried to explain to you how we are organised in the UK. I have explained that basic science is supported through a dual system involving the Research Councils and the University Grants Committee. Applied research and development is supported by the Government through the customer/contractor principle and decisions and priorities are reached using a wide range of external advice. I have mentioned the growing importance of collaborative R&D, both within the UK and internationally, and I am sure that there are opportunities for collaboration to be extended further. For example I have noted with interest the progress made so far on collaboration between European countries in work on measurement standards and the EUROMET discussions seem to offer good prospects of success. In my talk I have also described non-Frascati activities which are not strictly R&D but which are nevertheless essential if we are to encourage innovation.

Perhaps Mr Chairman I might be allowed one final comment. Basic research in the United Kingdom has been a substantial strength for many years, as can be seen by the long list of Nobel prize winners from my country. We are proud of the achievements of our scientists. However we recognise that we have not always been as adept at exploiting the results of their inventiveness. Accordingly the Government is giving increasing attention to the need to strengthen the links between basic science and its exploitation. We hope in this way to put to better advantage the strengths that we have.

8700
CSO: 3698/M433

ITALIAN COMMITTEE FOR HIGH TECHNOLOGY ESTABLISHED

Rome GAZZETTA UFFICIALE DELLA REPUBBLICA ITALIANA in Italian No 162, 14 Jul 87 pp 13-14

[Text] Decree of the Prime Minister:

On the basis of law No 770 of 11 November 1986 establishing government contractual procedures for the implementation of research programs and the acquisition and maintenance of high technology products, and with special reference to Article 1 which establishes that government administrations, including autonomous bodies, may stipulate contracts for the research and development of prototypes necessary to satisfy their knowledge requirements on which to base the acquisition of high technology plants, materials, machinery, and equipment;

On the basis of the first paragraph of Article 5 of the aforementioned law, under which the contracts specified in Article 1 of said law and referred to above must be forwarded by government administratons, including autonomous bodies, to the prime minister for coordination of the relevant research and development programs, in order to avoid possible areas of conflict or duplication of programs or parts of programs and to ensure a rational utilization of the results obtained;

Considering that, in order to carry out the tasks of coordination and guidance established by the aforementioned article, it is necessary to take into account the entire range of research initiatives in progress, as well as the research contracts covered by law No 46 of 17 February 1982, the possibility of disclosure of the results, and the impact of these results on national security and the quality of life;

On the basis of the general mandate for the coordination of Italian scientific and technological research granted to the minister for scientific and technological research by the prime minister;

Having taken note of the need for the creation of a technical committee, in compliance with the provisions of the aforementioned paragraph 1 of Article 5 of law No 770 of 11 Nov 1986;

Given that the aforementioned committee must be composed of qualified

representatives of government administrations, with specific in-depth economic, financial, and procedural expertise in the area in question and related aspects, as well as of [qualified representatives of] the National Research Council in the latter's role as the government's scientific advisory body;

In agreement with the minister for coordination of scientific and technological research:

Hereby Decrees:

Article 1

The technical committee specified in paragraph 1 of Article 5 of law No 770 of 11 November 1986 is to be composed of the following members:

1) the minister for scientific and technological research, in the role of chairman;
2) two representatives of the minister for scientific and technological research;
3) two representatives of the treasury (one from the Central Government Accounting Office and one from the Central Government Stationery Office);
4) one representative of the Education Department;
5) one representative of the Defense Department;
6) one representative of the Health Department;
7) one administrative magistrate of a rank not lower than member of the Council [consigliere];
8) one magistrate from the Government Auditor's Office of a rank not lower than member of the Council;
9) one government attorney in salary class III;
10) the director of the National Research Council.

The [committee] members specified in points 2) to 6) above must hold the rank of general manager [dirigente general - Italian civil service rank] or the equivalent.

The office of [committee] secretary will be performed by an executive (at managerial level) from the department of the minister for scientific and technological research. This office can be performed by a substitute appointed for this purpose.

The [committee] members mentioned in the preceding paragraphs are to be nominated by the competent administrations and then appointed by a decree of the minister for scientific and technological research.

Article 2

The technical committee specified in Article 1 will examine contracts covered by Article 1 of law No 770 of 11 November 1986, to ensure that they meet the orientation guidelines for the rational utilization of the results obtained and for possible areas of conflict or duplication of programs or parts of programs.

To do this, the committee will work with the minister for the coordination of scientific and technological research in defining the procedures considered necessary for implementation of the tasks specified in paragraph 1 of Article 5 of the aforementioned law.

Article 3

The sessions of the committee will be attended by one or two advisers who are to be highly qualified experts, selected for each session by the minister for scientific and technological research on the basis of the areas related to the subjects examined by the committee at that particular session.

In addition, the minister may invite representatives of other government administrations, including autonomous bodies, to act as advisers on the subjects being dealt with in the various sessions, and this can also be done on the specific request of the aforementioned administrations.

Article 4

The committee is considered to be validly constituted when half the number of committee members plus one are present. The committee decisions will be taken with a majority vote; in the event of a hung vote, the chairman of the committee will have the deciding vote.

The subjects examined by the committee will be described by the chairman of the committee or by a person appointed by the chairman.

The matters discussed by the committee are to be considered secret.

Article 5

The instructions required to implement the procedures relating to the work of the committee specified in Article 1 are to be given in the form of special circulars issued by the minister for scientific and technological research, following consultation with the committee.

For all procedural matters connected with the activities dealt with in this document, the minister will use the structures within his department responsible for handling the research contracts covered by law No 46 of 17 February 1982.

This decree is to be published in the GAZZETTA UFFICIALE DELLA REPUBBLICA ITALIANA.

Rome, 9 July 1987

The Prime Minister: Farfani

8616
CSO: 3698/M390

BMFT, RESEARCH SOCIETY DEBATE BASIC RESEARCH SUBSIDIES

Duesseldorf VDI-NACHRICHTEN in German No 29, 17 Jul 87 p 1

[Article by G.H. Altenmueller: "Subsidies Guarantee Creativity;" first paragraph is VDI-NACHRICHTEN introduction]

[Excerpt] VDI-N Duesseldorf, 17.7.87--The forthcoming tax reform will also change the research scene. Indirect forms of research and development subsidies which were previously commended as progress will be given up. Basic researchers, too, fear that their share of government subsidies could be included on the list of cutbacks.

More and more university scientists turn to the German Research Society (DFG) for financial help for their projects. In the last 25 years, colleges have been developed at a cost of approximately DM50 billion. The financially weak lands, however, are no longer able to use this investment or pay for research projects. Funds for this purpose are available from the DFG but these are also scarce. With a little over DM1 billion per year, the DFG can only barely guarantee the existing freedom [of action] in basic research. To deny [funds for basic research] would be an "uneconomical insanity," DFG Chairman Professor Hubert Markl stated at the DFG annual meeting on 7 July in Berlin. Markl's fears do not appear unrealistic in light of budget cuts in the last 2 years and the opinion held by many politicians that these subsidies, rather than being an investment expenditure for the future, should be reduced or eliminated as part of the tax reform.

Research minister Dr Heinz Riesenhuber never tires of assuring that he subsidizes basic research particularly heavily--in the past years the budget for basic research rose from 26 percent to 35 percent. However, this increase derives mostly from direct project grants as well as from special funds appropriated by the DFG. However, this excludes the most important criterion: assessment of scientific quality.

A new form of research subsidy has become the focal point: cooperative research between industry and research institutes. Cooperative research helps to build up and ensure economic capacity both in basic and applied research. This is absolutely essential, because now that the BMFT has sharply reduced direct subsidies to R&D projects in industry, indirect subsidies--until now a trademark of the Christian-Liberal research policy--are also under fire. The program of the Federal Economics Ministry, "subsidies for R&D personnel costs"

will end in 1988, a year earlier than planned, and at the same time, the BMFT's program on personnel cost increases and pilot project "technology oriented companies," will also come to an end. The same is being considered for the additional allowances for R&D investment. These cutbacks will doubtless be accelerated by the subsidy fraud case regarding personnel cost grants which is now being examined by the attorney general.

However, the cutback in subsidies due to the tax reform reflects over DM1 billion annual reduction affecting, in particular, small and medium sized companies. While German government economic departments are supporting this, the German industry union has strong fears that the hard-won balance in the research subsidies could be lost. How doubtful are the expectations that tax relief could stimulate the companies to greater R&D activity is demonstrated by the opinions at the BMFT regarding the search for problems which arise in small and medium sized companies and which cannot be solved by the tax reform. The program for subsidizing ongoing contract research could be a start, as could cooperative research. In any case the BMFT wants to prevent the hard-won and--in comparison to Japan--still insufficient momentum of industrial R&D from lagging behind again.

8701
CSO: 3698/M407

R&D SUPPORT SYSTEMS OF WESTERN EUROPE, JAPAN EXAMINED

Bonn TECHNOLOGIE NACHRICHTEN PROGRAMM INFORMATIONEN in German No 402, 16 Jun 87 pp 2-3, 6-13

[Document entitled "Comparison of Research Funding of Western Industrialized Countries" issued following a meeting of U.S., West German, French, British, and Japanese science policy experts in Bonn, 26-27 May 1987]

[Excerpts] 1. Introduction

As a result of the increasing internationalization of research, development, and innovation, along with the globalization of economic competition, the question of the position of individual nations in research and development has become increasingly important. A decisive role is played here by the national research and technology systems, with the funds and personnel at their disposal, their structure and type of organization and their flexibility and dynamics.

With regard to these factors, we have first attempted to set up a quantitative analysis of the basic positions of five test nations: the United States, Japan, the FRG, France and Great Britain (see tab. 1-4). Certain frequently discussed difficulties that stand in the way of an international research and development comparison shall not be considered here. These difficulties include the definition of R&D, the use of relative values such as R&D intensity, national plans, industrial R&D expenditures as a proportion of sales, as well as a survey of R&D personnel.

As a rule, only the input side of the research system will be considered in this comparison. The results--the output in the form of technological competitiveness or scientific achievement--are not analyzed here. The figures given in this study are based on internationally correlated statistics. Exact figures for the years 1986 and 1987 are only available for the public sector.

The Distribution of R&D Expenditures in the Economy

Japan has the highest private R&D expenditures for 1986 with 77.8 percent, which must also be seen in a strongly consensus-oriented context. The FRG follows with 58.8 percent. This is one of the decisive starting points for a comparative analysis of the cooperation between public and private R&D activities. In assessing the French situation, the high proportion of nationalized industry must be considered.

The following statistics are recorded for the purpose of comparing national R&D expenditures (year of reference 1985):
--The United States spends almost 5.5 times as much on R&D as the FRG;
--Japan twice as much as the FRG;
--The FRG spends 37 percent more on R&D than France and 47 percent more than Great Britain;
--Japan's per capita R&D expenditures are almost equal to those of the FRG, while the United States spends over 20% more (1986);
--the ratio of researchers in the FRG, Japan, and the United States is 1:3:5.5 (1984);
--in all five nations private enterprise is the largest sector involved in R&D.

The results with regard to the FRG private sector (1986) in the comparison are as follows:
--The German private sector maintains the same leading position as the United States, with 79 percent of the overall involvement in R&D. Japan and Great Britain follow with almost 65 percent each and France with approximately 55 percent.
--Self-financing by the German private sector (R&D is carried out upon receipt of funds) is 81 percent, the second highest after Japan (98 percent). The corresponding figures for the United States and Great Britain are 67 percent and 63 percent, respectively, and 72 percent for France (1984).

In a study of the dynamics of R&D growth, other key points become apparent. In the 5 years between 1980 and 1985, the R&D budgets of the five test nations have shown the following average rates of real growth (left-hand column); the dynamic trend of the economy can be seen in the right-hand column:

Japan	7.0%	8.5%
France	5.0%	4.5%
United States	4.0%	4.3%
FRG	2.9%	3.4%
Great Britain	1.9%	2.0%

This shows that all five countries have made great R&D efforts over the last 5 years. In the case of Great Britain, it is apparent that the overall development is lower than that of the other four test nations.

With the exception of France, the dynamics of the private sector are proportionately stronger than in the public sector for all countries.

The leading position achieved by Japan is obvious. This position is reinforced by the numerous organizational changes made by Japan in its research and technology system since 1980. These changes are aimed at an

improved coordination of the individual system elements as well as at an acceleration of the process of internationalization.

Japan

A comparison of Japan's research and technology system with that of the FRG shows a stronger trend toward centralization in Japan which is reflected--among other things--in the lesser responsibilities of the Japanese prefectures compared to the German lands as well as in the budgetary authority which is held almost exclusively by the central government in Tokyo.

The efficiency of the Japanese research and technology system is based mainly on the close integration of information, R&D personnel, and financing. This facilitates not only the bridging of gaps between individual scientific disciplines, institutions and sectors but also the decisionmaking process.

Japan's national R&D budget amounts to 9 trillion yen (1986) (DM108 billion with an exchange rate of 100 yen = DM1.20). The proportion of the gross national product is 2.7 percent. Per capita expenditures amount to a nominal DM890.

22.1 percent of the R&D budget is financed by the state and 77.8 percent by private enterprise. The relatively high participation of universities in R&D activities--23 percent--is noteworthy compared to less than 70 percent on the part of private enterprise, 66 percent to be exact (in particular private universities are mostly financed by private enterprise).

The rate of self-financing within the private sector is, at 98 percent, the highest of five test nations.

The R&D activities of the Japanese economy are concentrated mainly in the processing industries. Four sectors account for over 70 percent of R&D expenditures, led by the electrical and electronics industry with 30 percent, followed by the chemical industry (17 percent), automobile industry (18 percent), and mechanical engineering (7 percent).

This R&D financing structure must be seen in terms of the extremely low proportion of the national R&D budget allocated to military R&D, which accounts for less than 1 percent (1986).

With regard to researcher potential, there are no statistics for full-time R&D activity. Available statistics state that Japan has 370,000 researcher (scientists and engineers) at its disposal (1984). That is approximately half of the researcher potential of the United States.

A high concentration of R&D in the private enterprise sector is caused by the fact that three large branches--the chemical industry, the steel, mechanical engineering, automobile and electronics industry, and the precision engineering and optics industry--are involved in the execution of R&D to the extent of 80 percent.

Two further indicators complete the picture: the proportion of military R&D and the R&D personnel capacity.

The FRG allocates 4.8 percent of its R&D expenditures for military purposes and, correspondingly, 95.2 percent for civil purposes.

With regard to the number of researcher, the most important factor for every nation, there are 130,000 in the FRG (1984, scientists and engineers, statistic converted to full time).

France

The research and technology system in France can still be regarded as the most centrally organized of the five test countries although the emphasis has shifted in recent years from the Ministry of Research and Technology (MRT) (1981), to the Ministry of Industry and Research (MIR) (1982), to the present Ministry of Research and Higher Education (MRES) (1986). This has led to a definite shift of the relationship between R&D and the universities on the one hand and industry on the other. Furthermore, attempts at decentralization have led to the various regions gaining greater importance.

Unlike the FRG, France also has a ministry for industry in addition to the research ministry and the economic ministry. Along with its own budget for the subsidy of public research facilities, the present MRES also administers the civil budget for research and development (Budget Civil de Recherche et de Development technologique--BCRD), which covers the large technological programs excluding expenditures for defense, telecommunications, university salaries, and regional R&D expenditures.

France's national R&D budget amounts to Fr 114 billion (1986) (DM37.1 at an exchange rate of Fr 100 = 32.50); 54.4 percent is financed by the state and 41.3 percent by private enterprise (1984).

Private enterprise was involved to the extent of 57 percent in the execution of R&D, and the universities and institutes (public and private) 43 percent. The ratio between the R&D financing percentages and the R&D execution percentages is a reflection of the continuing weakness of the French economy.

The rate of self-financing by private enterprise is, at 72 percent, significantly lower than that of Japan and the FRG.

A decisive factor in the assessment of the situation, and one that cannot be ignored here, is the continuing relatively high proportion of nationalized industry.

France also has a relatively high concentration of industrial R&D. The following five sectors represent 83 percent:

--electrical, electronic, computer industry	29.0 percent
--chemical, pharmaceutical, petrochemical	18.6 percent
--aeronautical industry	18.0 percent
--automobile industry	11.0 percent
--foundry and toolmaking	6.4 percent

The proportion of the national R&D budget allocated to military R&D is 22.6 percent and, therefore, lower than the 30 percent figure exceeded by Great Britain and the United States.

France's researcher potential rose between 1982 and 1983 by 2,500 scientists and engineers to a total of 92,700.

Great Britain

The research and technology system in Great Britain has a strictly decentralized structure. There is no public R&D budget and the individual departments are, to a large extent, free to decide on their own R&D policy, whereby the actual R&D activities occupy a secondary function in relation to the prelimary departmental tasks. Two departments represent a certain exception: the Department of Education and Science, which finances basic research, and the Department of Trade and Industry, which promotes research for industrial applications. It may also be observed that the function of parliament is more concerned with the identification of problematic areas and their analysis than with a purely financial monitoring and control of funds.

The coordination problems arising from this situation are compensated by, among other things, by the Chief Science Advisor, the chief scientists of the departments, advisory boards and councils, and by the "Select Committees on Science and Technology."

Great Britain's national R&D expenditure for 1986 is estimated at 8.3 billion pounds.

The central government finances an average of 48 percent of national R&D expenditure and private enterprise 44 percent. The public sector is involved to the extent of approximately 23 percent and private enterprise to the extent of 63 percent.

85.3 percent of public sector expenditures are concentrated in three ministries (1983/1984):

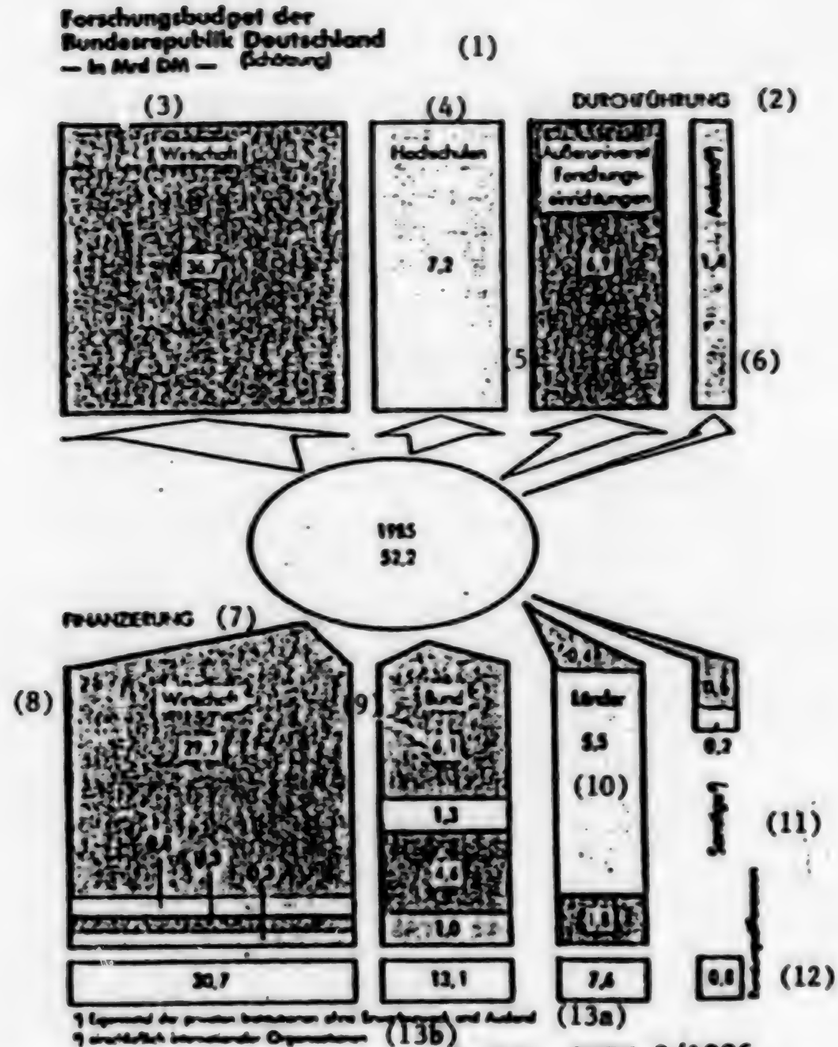
--Ministry of Defense	50.1%
--Departments of Education and Science (incl. University Grants Committee and Research Councils)	26.5%
--Department of Trade and Industry	8.7%

Of the national R&D budget 30.7 percent is allocated to military R&D; the proportion for civil application is, correspondingly, 69.3 percent (1986). The so-called "Science Budget" administered by the Department of Education and Science represents 25 percent of public funding. It is based on a 5-year plan system which is reviewed annually. Funds go mainly to the universities and research institutes of the five research councils for both basic and applied research.

Industrial R&D expenditures are concentrated mainly in five branches: electronics, chemical industry (including the pharmaceutical industry), aeronautics and space travel industry, mechanical engineering, and automobile manufacture.

The statistics regarding the researcher potential in Great Britain (1984: 94,000 scientists and engineers) are limited to the governmental and industrial sectors.

Figure 1:



Quelle: BMFT 3/1986

Key:

1) Research budget for West Germany in billion DM (estimate)
2) Execution
3) Private sector
4) Universities
5) Non-university research facilities
6) Foreign countries
7) Financing
8) Private sector
9) Federal government
10) Lander (autonomous German states)
11) Others
12) Average differences
13) a. Self-financing of private institutions without profit producing functions and foreign countries.
    b. Including international organizations

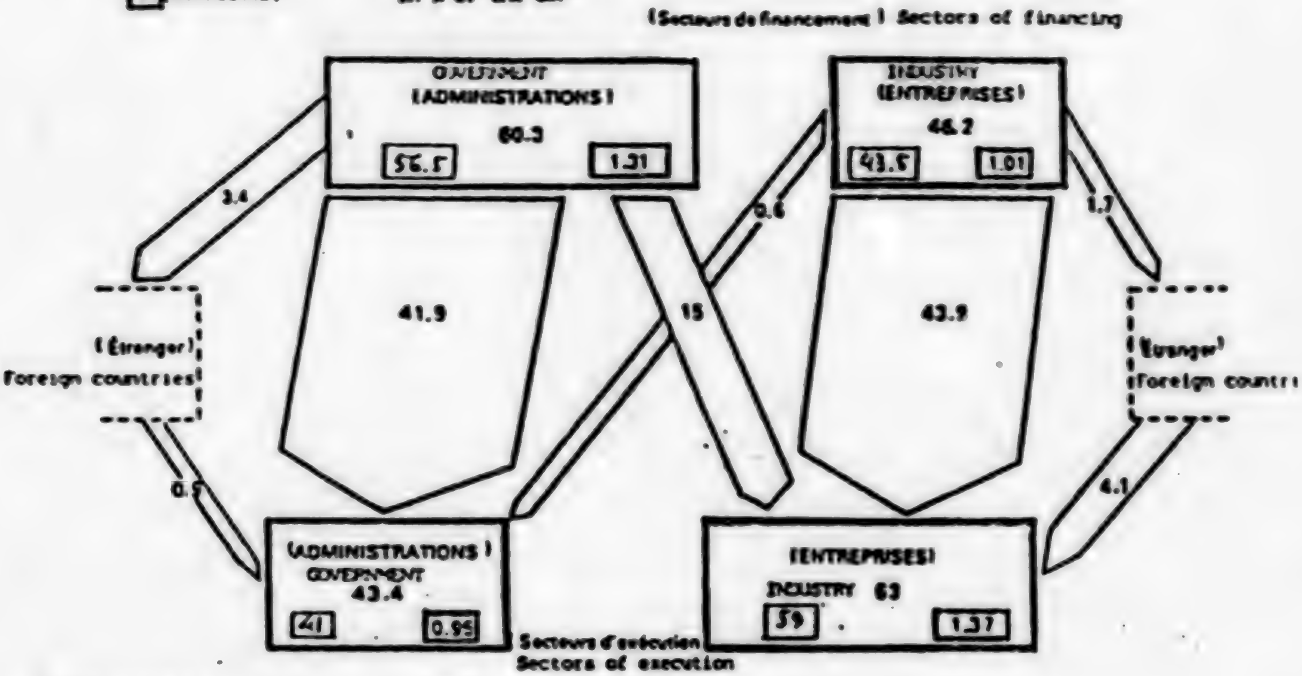
Financing and research execution structure in France

(Structures de financement et d'exécution de la recherche en France)

1995 (données provisoires) (provisional data)

x (en milliards F) In FF thousand millions

y (en % du PIB) In % of the GDP



Source : MRES

Table 1: Comparison of U.S.A., Japan, West Germany, France, Great Britain

Tabelle 1: Vergleich USA, Japan, BRD, Frankreich, Großbritannien

		USA		Japan		Deutschland		Frankreich		Großbritannien	
(1)	Basisdaten	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985
(2)	Bevölkerung (in Mio)	236,7	239,3	120,0	120,6	61,2	61,0	54,9	55,2	56,4	56,5
(3)	Erwerbstätige (in Mio)	112,34	114,59	60,9	61,33	25,79	25,67	21,43	21,38	23,54	24,2
(4)	Arbeitslosenquote (%-Anteil)	7,4	7,2	2,7	2,6	8,0	8,6	9,9	10,3	11,8	12,3
(5)	Bruttoinlandsprodukt (in Mrd DM)	10342,8	11272,4	3371,3	3667,5	1754,3	1835,9	1312,7	1402,3	1204,8	1293,9
(6)	Anteile an Weltsozialprodukt (in %)		23,7		11,9		6,5		4,9		4,4
(7)	Arbeitskosten in der Verarbeitenden Industrie (DM pro Stunde)	36,47	38,51	22,04	23,62	29,32	29,87	21,58	22,85	17,77	18,51
(8)	Anteile am Welthandel (in %)	14,4	14,5	7,8	7,7	8,3	8,7	5,1	5,2	5,2	5,3

Key:
1) Basic data
2) Population in millions
3) Employed in millions
4) Rate of unemployment in %
5) Gross national product in DM billions
6) Percentage of world production
7) Labor costs in the processing industry (DM per hour)
8) Percentage of world trade

Table 2: OECD R&D data for 1984 and 1985 (temporary)

[illegible]

	USA 1984	USA 1985	Japan 1984	Japan 1985	Deutschland 1984	Deutschland 1985	Frankreich 1984	Frankreich 1985	Großbritannien 1984	Großbritannien 1985
(1) [illegible]										
(2) - [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible][1]	[illegible]
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible][1]	[illegible]
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible][1]	[illegible]
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible][1]	[illegible]

	USA 1982	USA 1983	USA 1984	Japan 1982	Japan 1983	Japan 1984	Deutschland 1982	Deutschland 1983	Deutschland 1984	Frankreich 1982	Frankreich 1983	Frankreich 1984	Großbritannien 1982	Großbritannien 1983	Großbritannien 1984
(3) [illegible] (4) [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible][2]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	[illegible]	[illegible][3]

(5) 1) [illegible]
2) [illegible]
3) [illegible]

(6) [illegible]
[illegible]
[illegible]

Key:
1) Gross national expenditures
2) --in $ billions
--annual growth in fixed prices
--percentage of gross national product
--financed by public funds in percent
--financed by industry in percent
3) Researchers (scientists and engineers)
4) Converted to full time: in 1,000
5) 1)Figures for 1983
2)Not converted to full time
3)Governmental and industrial sector only
6) Source:
Gross national expenditure: OECD, Rapid Results, print-out, 30 Apr 1987
Researchers: NSF, International Science and Technology Data Update 1986

Table 3a: Structure of R&D financing

Tabelle 3a

Struktur der FE-Finanzierung

FE-Daten 1986 (Schätzungen)	USA	Japan	BRD	Frankreich	Großbritannien
Nationale FE-Budgets (Inlandsdurchführung in Mrd DM)	202,8	109,0	53,0	27,0	25,0 (1983)
Zuwachsraten 1985/86 nominal in %	9,5	7,1	6,2	6,0	5,4 (1981/1983)
real in %	4,4	4,6	3,6	2,0	0
Anteil FE-Budget am Bruttoinlandsprodukt in %	2,85	2,72	2,77	2,31	2,24
FE-Aufwendungen pro Kopf der Bevölkerung					
- nominal 1986 in DM	1170	870	870	580 (1984)	450 (1983)
- nominal 1980 in DM	890	540	610	460 (1982)	400 (1981)
Finanzierung des FE-Budgets 1986 in %:					
- Staat	48,7	22,1	38,7	54,4 (1984)	48,9 (1983)
- Wirtschaft	47,8	77,8	59,8	41,3 (1984)	43,6 (1983)
- Übrige (z.B. private non-profit) und Ausland	3,5	0,1	1,5	4,3	7,5

Key:

1) R&D data 1986 (estimates)
20 National R&D budgets (domestic execution in DM billions)
3) Growth rates 1985/86 nomial in percent
   real in percent
4) Proportion of GNP allocated to R&D in percent
5) R&D expenditure per capita population
   -nominal 1986 in KM
   -nominal 1980 in DM
6) Financing of R&D budget 1986 in percent
   -state
   -private sector
   -others (e.g. private non-profit) and foreign countries

Table 3b: Structure of R&D execution

Struktur der FE-Durchführung

(1) FE-Daten 1986 (Schätzungen)	USA	Japan	BRD	Frankreich	Großbritannien
(2) Empfänger der FE-Mittel des Staates 1986 in %					
- Wirtschaft	51	5	41	23 (1984)	30
- Hochschulen	19	52	25	77 (1984)	29
- Institute	30	43	31		41
(3) Empfänger der FE-Mittel der Wirtschaft 1986 in %					
- Wirtschaft	99,5	82,1	98,2	98,7	91,4
- Hochschulen	0,9	13,7	0,6	1,3	0,9
- Institute	0,6	4,2	1,2		7,7
(4) FE-Durchführung 1986 in %					
- Wirtschaft	73	64	73	57	63 (1983)
- Hochschulen	12	23	14	43	12 (1983)
- Institute	15	13	13		25 (1983)
(5) FE-Durchführung Wirtschaft: Herkunft der Mittel 1986 in %					
- Wirtschaft (Eigenfinanzierungsquote)	67	98	81	72 (1984)	61
- Staat	33	2	18	22 (1984)	30
- Sonstige	—	—	1	6 (1984)	9
(6) FE-Aufwendungen der Zentralregierung 1986 in %					
- zivil	30,3	95,9	80,0	68,7	47,7
- militärisch	69,7	4,1	20,0	31,3	52,3

(7) Quelle: Dipl.-Volksw. A. Blum, Lahmeyer International, 1987

Key:
1) R&D data 1986 (estimates)
2) Recipients of R&D funding by the state 1986 in percent
   -private sector
   -universities
   -institutions
3) Recipients of R&D funding by the private sector 1986 in percent
   -private sector
   -universities
   -institutions
4) R&D execution 1986 in percent
   -private sectors
   -universities
   -institutions
5) R&D execution by the private sector:
   Origin of funds 1986 in percent
   -private sectors
   -universities
   -institutions
6) R&D expenditure by central government 1986 in percent
   -civil
   -military
7) Source: A. Blum, Lahmeyer International, 1987

Table 4: Proportion of national R&D budget allocated for military and civil purposes

[illegible]

[illegible]

	USA	Japan	Deutschland	Frankreich	Großbritannien
(1) [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(2) [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(3) [illegible]					
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(4) [illegible]					
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(5) [illegible]

Key:

1) National R&D budget 1985 in DM billions
   -military
   -civil
2) National R&D budget 1986 in DM billions
   -military
   -civil
3) Proportion share of national R&D budget 1985 in percent
   -military
   -civil
4) Proportion share of national R&D budget 1986 in percent
   -military
   -civil
5) Source: A. Blum, Lahmeyer International, 1987

8706
CSO: 3698/M394

BRIEFS

AUSTRIAN FIRM SEEKS EC RESEARCH ROLE--Austrian high-tech entrepreneurs are now also taking part in the discussion concerning the possibility of an Austrian approach to the EC. Sven Uwe Stengl, the vice-chairman of the managing board of Schrack Elektronik AG, appealed to all those responsible to take the necessary steps toward an approach as quickly as possible. Austria, Stengl said, has wasted 15 years; however, it is not yet too late. Schrack knows from its own experience that intensified cooperation can, in the end, only lead to advantages for the company, Stengl said. The only way to reamin competitive is to cooperate in international research projects in order to "be where the knowledge is. "An example of Schrack's efforts in participating at an international level may be seen in the successes obtained in the ESA projects. With regard to the most recent project, Schrack Elektronik soon expects a contract for cooperation on a study within the framework of the Data Relay Satellite Preparatory Program (DRPP). The Austrian company's primary role will be to examine interference of relay quality caused by radar systems on earth. [Text] [Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 459-460, 20 Jul 87 p 20] 8701

CSO: 3698/M403

BRAZILIAN SATELLITE PROGRAM

36990005 Sao Paulo GAZETA MERCANTIL in English 20 Apr 87 p 6

[Text]

The Instituto de Pesquisas Espaciais (INPE), the space research institute based in São José dos Campos, São Paulo, in October will inaugurate the LIT laboratory to be used for testing Brazil's future satellites to be launched beginning in 1989.

The $23 million laboratory is part of a program developed by the Technical Aerospace Center (CTA) and INPE that will launch four satellites, two of which will collect climatic data.

The climatic satellites, which weigh about 115 kilos (253 lbs.) each, will orbit at an altitude of 750 kilometers (460 miles) at a 25-degree inclination to the equator. They will collect data to be used for climatology, meteorology and hydrology.

Still being studied are proposals for two remote sensory satellites capable of capturing images from 650 kilometers (404 miles) away for data that would be used in studying natural resources, cartography, and pollution.

Marco Antonio Raupp, INPE director, said the LIT laboratory will be used by federal institutions like Embratel, Brazil's international telecommunications authority, and Telebrás, the holding company for telephone companies. He added that the lab can be used by the private sector to test electronic or aeronautic equipment.

Argentine satellite technology will also benefit from the Brazilian lab. Argentina plans to launch its SAC-1 satellite, to be constructed in collaboration with NASA, in 1992.

An agreement was signed in July between INPE and the Comisión Nacional de Investigaciones Espaciales in Buenos Aires that approves the training of Argentine engineers in the Brazilian space program, while Brazilian engineers will help develop SAC-1.

• Science & Technology Minister Renato Archer has agreed to give Cz$ 400 million ($8 million) to the state of Rio Grande do Sul for investing in remote sensory studies, meteorology and biotechnology.

Archer said the state will use the funds to install a center in Porto Alegre for interpreting digital images transmitted by satellite to computers.

/9274

JOINT VENTURES TO BUILD AIRCRAFT PLANNED

36990007 Madrid EFE in Spanish 1049 GMT 7 Oct 87

[Text] London, 7 Oct (EFE)—Fabrica Militar de Aviones (FMA), the Argentine Air Force aeronautics firm, will participate in a joint venture with foreign firms to build military and civilian aircraft.

According to a report published in the latest issue of the publication *Jane's Defence Weekly*, which is published in London, the new company will operate under the name of Fabrica Argentina de Materiales Aerospaciales (FAMA).

The Argentine Air Force will participate in FAMA with 46 percent of the shares, Aeritalia with 44 percent, and Techint [not further identified] with 10 percent of the shares.

Air Force Brigadier Generals Ruben Oscar Corradetti and Roberto Engroba—Engroba is the director general of the Cordoba materiel unit and the person in charge of the FMA—will be in charge of FAMA, which will continue to manufacture the IA-63 Tampa trainer plane and the new Argentine-Brazilian CBA-123 light transport plane.

The FMA is studying the possibility of an agreement for joint operations with the Spanish firm Iberica Empresa de Explosivos Alabases.

/9274 END

END OF FICHE

DATE FILMED

1 February 1988